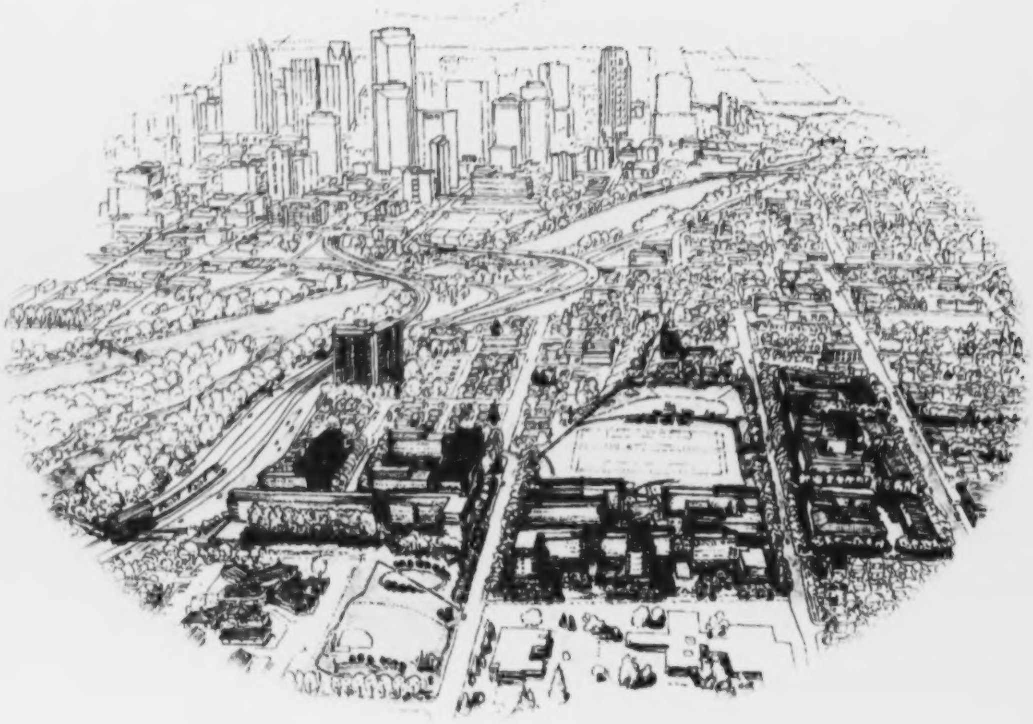
BOW VALLEY CENTRE CONCEPT PLAN

BRIDGELAND-RIVERSIDE AREA REDEVELOPMENT PLAN



Part 1 and Part 2, Chapters 1 to 8 under separate cover

THE CITY OF
CALGARY
PLANNING & TRANSPORTATION POLICY

103-03487/

The Blue Pages of this document contain supporting information and do not form part of the bylaw.
For the purposes of electronic publications the Blue Pages are identified by the footer "Bridgeland-Riverside Area Redevelopment Plan 2000 - Supporting Information".

BOW VALLEY CENTRE CONCEPT PLAN

BRIDGELAND-RIVERSIDE AREA REDEVELOPMENT PLAN

Part 1 and Part 2, Chapters 1 to 8 under separate cover

The Bow Valley Centre Concept Plan (25P2000) is an amendment to the Bridgeland-Riverside Area Redevelopment Plan (11P80) which is under separate cover.

PUBLISHING INFORMATION

TITLE:	Bow Valley Centre Concept Plan Bridgeland-Riverside Area Redevelopment Plan
AUTHOR:	Land Use Planning Division
STATUS:	Approved by City Council - 1980 September 3 - 11P80
PRINTING DATE:	2003 February
ADDITIONAL COPIES:	The City of Calgary Planning & Transportation Information Centre #8115 P.O. Box 2100, Stn. M Calgary, Alberta T2P 2M5 Phone: (403) 268-5333 Fax: (403) 268-4615 Web: www.calgary.ca/planning go to: Land Use Planning go to: Publications

BOW VALLEY CENTRE CONCEPT PLAN
BRIDGELAND-RIVERSIDE AREA REDEVELOPMENT PLAN

Part 1 and Part 2, Chapters 1 to 8 under separate cover

TABLE OF CONTENTS

Page

Part 2

Preface 3

9.0 Introduction 3

Background 3
Study Area Description 3
Site Context 5
Plan Preparation Process 6

9.1 Redevelopment Objectives 7
9.2 Concept Plan 8
  9.2.1 Objectives 8
  9.2.2 Organizing Principles 9
  9.2.3 Major Land Use Components 9
  9.2.4 Urban Design Approach 13
  9.2.5 Sustainability, Urban Safety and Winter City Design 15
9.3 Land Use Policies 16
  9.3.1 Transit-Supportive Design and Development 18
  9.3.2 Residential 21
  9.3.3 Public Parks and Open Space 27
  9.3.4 Commercial/Retail Development 35
    9.3.4.1 1st Avenue 35
    9.3.4.2 LRT Station Area 38

Page

Part 2

9.4 Parking 39
  9.4.1 Residential 39
  9.4.2 Retail/Commercial 41
  9.4.3 Community Hall 41
  9.4.4 Office/Institutional Uses 42
9.5 Transportation/Public Systems 42
9.6 Implementation 46
  9.6.1 Outline Plan/Land Use Redesignation . 47
  9.6.2 Road Closures 47
  9.6.3 Phasing 48

LIST OF FIGURES

18. Study Area Boundaries 4
19. Conceptual Land Use Plan 10
20. Transit Service 20
21. Residential 23
22. Parks and Open Space 29
23. Proposed Street Network 45
24. Block Plan 49

LIST OF TABLES

Table 1 Summary of Land Use Policy Areas 17

Preface

The following amendment to the Bridgeland-Riverside Area Redevelopment Plan (ARP) is a result of a planning process to determine how the site of the former Bow Valley Centre should be redeveloped. This amendment is consistent with the goals and policies established in the Bridgeland-Riverside ARP as amended to 1995. However, it is important to note that the policies and content of this amendment pertain only to lands within the study area.

A series of "housekeeping" amendments to the main document also accompanies this amendment. These amendments update maps, text, and policies to reflect the current situation.

9.0 Introduction

Background

The Bow Valley Centre lands (former Calgary General Hospital) became available for redevelopment as a result of the 1997 closure and subsequent demolition of the Bow Valley Centre (BVC). The redevelopment of the subject lands presents a unique opportunity to achieve objectives that will benefit both the community of Bridgeland-Riverside and Calgary as a whole.

The planning process was launched in 1998 and was unique in two respects. It included a nation-wide design competition to generate ideas for the redevelopment of the site and an extensive public participation process, ensuring community input at every stage of the planning process. Finally, the more traditional market, engineering, and traffic studies were undertaken to identify feasible and marketable redevelopment opportunities.

This amendment to the Area Redevelopment Plan establishes the policies and guidelines that will guide the redevelopment of the BVC. These policies and guidelines apply only to those lands included within the boundaries of the study area (Figure 18). However, due to the centrality of the study area within the Bridgeland-Riverside community and the subsequent impacts of the redevelopment, it is anticipated that other amendments to the ARP will eventually be triggered. In particular, it is anticipated that the 1st Avenue business area should be re-examined to ensure that the potential benefits of this major redevelopment opportunity are realized to the greatest extent possible.

Study Area Description

The boundaries of the study area (Figure 18) are as follows:

- 8th Street NE and 7A Street NE on the west
- 1st Avenue NE on the north
- 9A St to Murdock Road (Centre Avenue), 10th Street (Cross Bow Auxiliary Hospital) to McDougall Road, 11th Street and the Calgary Metropolitan Foundation lands on the east
- Memorial Drive on the south.

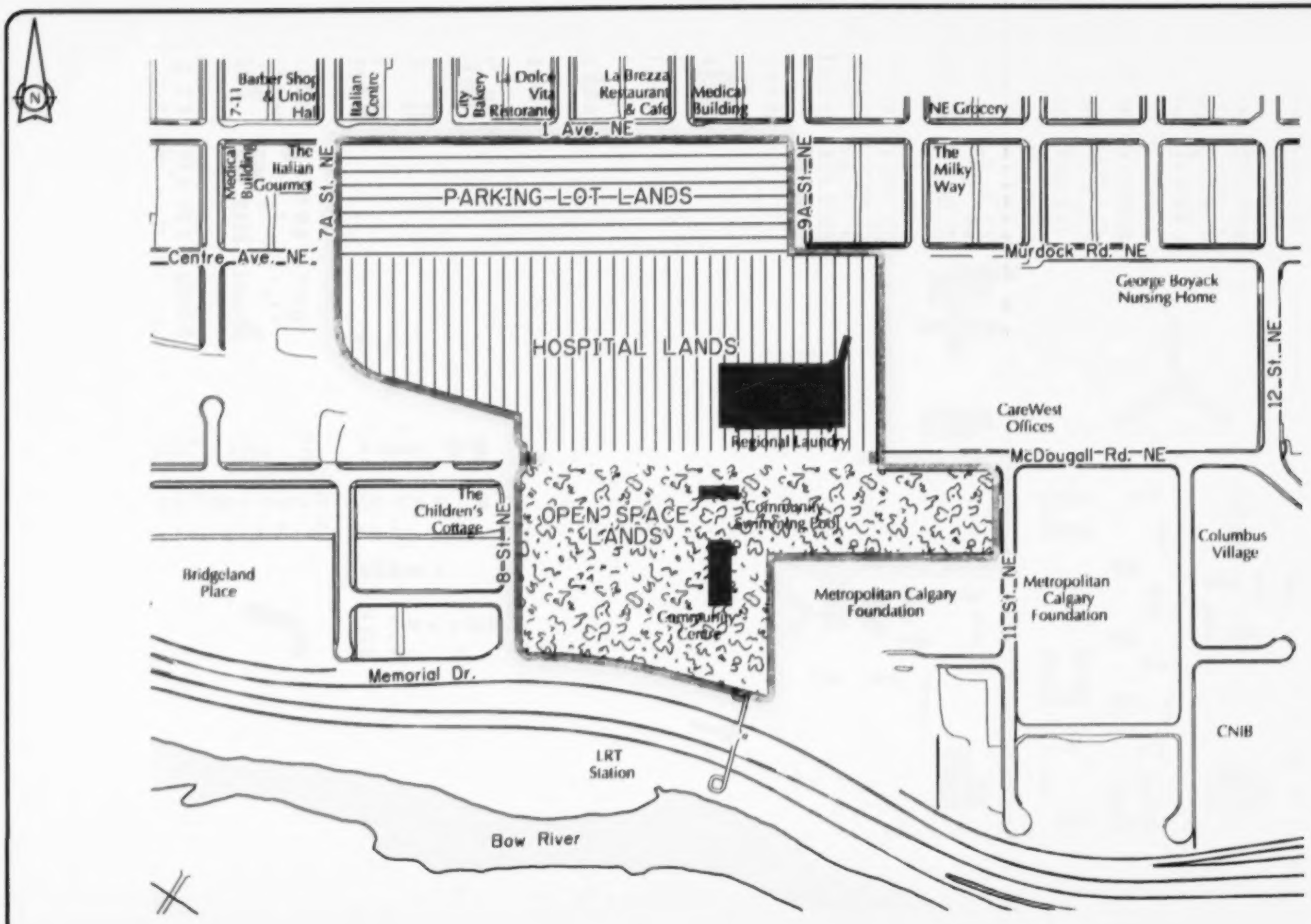

N
7-11
Barber Shop & Union Hall
Italian Centre
City Bakery
La Dolce Vita Ristorante
La Brezza Restaurant & Cafe
Medical Building
NE Grocery
1 Ave. NE
Medical Building
The Italian Gourmet
7A St. NE
PARKING-LOT-LANDS
9A St. NE
The Milky Way
Murdock Rd. NE
Centre Ave. NE
George Boyack Nursing Home
HOSPITAL LANDS
Regional Laundry
CareWest Offices
12 St. NE
McDougall Rd. NE
The Children's Cottage
8 St. NE
OPEN SPACE LANDS
Community Swimming Pool
Community Centre
Columbus Village
Bridgeland Place
Metropolitan Calgary Foundation
11 St. NE
Metropolitan Calgary Foundation
Memorial Dr.
CNIB
LRT Station
Bow River

Figure 18 Bridgeland – Riverside

Study Area Boundaries and Sub Areas

May 2002

THE CITY OF CALGARY
PLANNING & TRANSPORTATION POLICY

\\work\work\plan\plans\arp\bridgeland\sa_boundary.dgn

DATE PLOTTED 02-MAY-2002

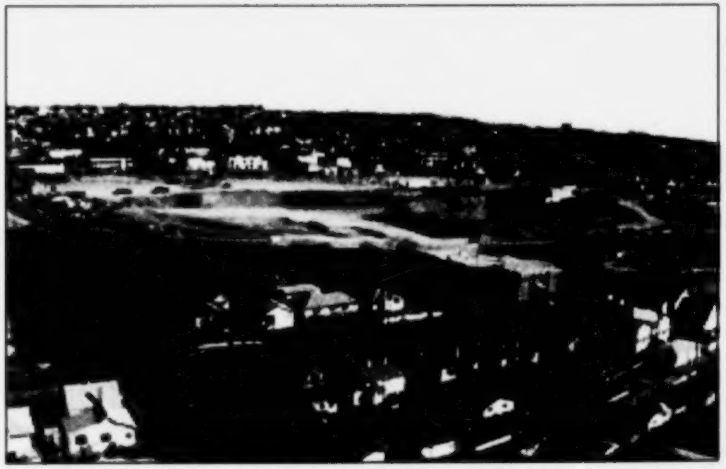
0 50 100 200
metres

The study area comprises three sub-areas, all of which are under title to The City of Calgary. The Parking Lot Lands extend from 1st Avenue to Murdock Road, the Hospital Lands lie between Murdock Road and McDougall Road, and the Open Space Lands extend south from McDougall Road to Memorial Drive and the Calgary Metropolitan Foundation lands. In total, the study area encompasses approximately 13.61 hectares (33.63 acres) of land.

Bow Valley Centre (Calgary General Hospital)

Site Context

The BVC study area is located centrally within the community of Bridgeland-Riverside and straddles the upper (Bridgeland) and lower (Riverside) portions of the community. 1st Avenue, on the north side of the study area, is the community's 'main street' characterized by the European flavour of some of the local businesses. The former hospital was the most predominant feature of both 1st Avenue and the community. The hospital was also a significant physical barrier, effectively dividing the community in two. For example, the hospital buildings stretched across the site and were a barrier for pedestrian access to the LRT Station, the community hall and Riverside Park. Also, the parking lot extended for four blocks along 1st Avenue - creating a significant break in the continuity of street-front development.



Redevelopment Site - after demolition of the hospital

Bridgeland-Riverside has 5 areas that are distinct from one another. Briefly, these are:

- 1st Avenue commercial street
- Edmonton Trail commercial area
- Low density residential area north of 1st Avenue
- Medium density area west of 6th St north of 1st and west of 8th Street and south of 1st Avenue
- Seniors' housing and institutional uses area south of Murdock Road.

Although the community has two focuses for activity - 1st Avenue and the community hall, there is no identifiable 'centre' where people can run into one another casually, meet for coffee, etc. The development on 1st Avenue is too dispersed and a number of the businesses do not cater to the local community but are regional destinations. The existing community hall is at the edge of the community and supports a range of activities for both local residents and groups and organizations from outside Bridgeland-Riverside.

The very mixed nature of development in Bridgeland-Riverside and the central location of the study area, present a significant opportunity for the redevelopment of the site to 'knit' the entire community into a cohesive whole. It will also create a new 'heart' for Bridgeland-Riverside by setting the stage for a more vibrant, active 1st Avenue and by locating the community hall and the major community park space closer to the center of the community, bringing it within walking distance of many more households.

Another significant opportunity presented by the redevelopment process is to take full advantage of the Bridgeland LRT Station located on the south-east corner of the site. The station was originally constructed to provide LRT access to the hospital and has not been used to its full potential due in part to the lack of transit-supportive development in the immediate vicinity of the station.

Plan Preparation Process

On 1997 December 15, City Council approved the Terms of Reference which outlined a five phase public planning process. The planning process was co-managed by The City of Calgary's Planning and Transportation Policy Business Unit and Corporate Properties Group, reflecting The City's dual roles in the project as planning approval authority and sole landowner.

The planning process began early in 1998 with the formation of the Planning Advisory Committee (PAC). The PAC comprised a cross-section of local community residents and citizens at large from the broader Calgary community. The PAC played a significant advisory role throughout the duration of the process in several key areas - design of the public consultation process, selection of a preferred concept plan, the review of the final land use concept plan, and ensuring an appropriate balance between city-wide and local community objectives.

One of the most unique aspects of the planning process was the inclusion of a planning design competition as a means to generate alternative ideas for the redevelopment of the site. A call for expressions of interest was advertised nationally and three design teams were selected to prepare preliminary concept plans. Each concept plan was assessed with respect to how well it addressed the project objectives. In addition, open houses were held to solicit public comment on the concepts. At the conclusion of the evaluation process, one of the concept plans was selected as the basis upon which the redevelopment plan was prepared.

An extensive public consultation process was also undertaken. One of the highlights of this process was a Co-Design Fair held early in the process to develop visions of the kinds of activities people wanted to be able to engage in and the kinds of environments needed to support those activities. Other highlights included an opportunity to meet the design teams who developed the preliminary concept plans, reviewing and commenting on the five concept plans produced through the design competition, and reviewing and commenting on the draft concept plan and Area Redevelopment Plan Amendment. Details of the public consultation process are included in the Background and Supporting Information Section and in Appendices IV-XI.

9.1 Redevelopment Objectives

Objectives for the redevelopment process were approved by City Council as part of the Terms of Reference for the planning process. The complete list of objectives is found in Appendices I-III. Redevelopment objectives focused on the following:

- Sensitive housing intensification
- Wider range of housing choices for different age and income levels
- Transit-supportive development, including mixed-use development
- Pedestrian and cycling supportive public systems that connect well with adjacent lands
- An improved physical environment
- Enhanced viability of 1st Avenue businesses
- Exploration of opportunities for innovation in residential and mixed-use development, including special needs and affordable housing
- Optimizing the distribution of open space and community facilities in relation to the needs of Bridgeland-Riverside residents and ensuring that the quality of facilities and amount of open space is equal to or better than that in place prior to redevelopment
- Providing a commemorative area that recognizes the contributions of the Calgary General Hospital and its role within the city.

In addition, the redevelopment process is intended to incorporate implementation and marketing strategies that will ensure the site can be developed in a feasible and economic manner.

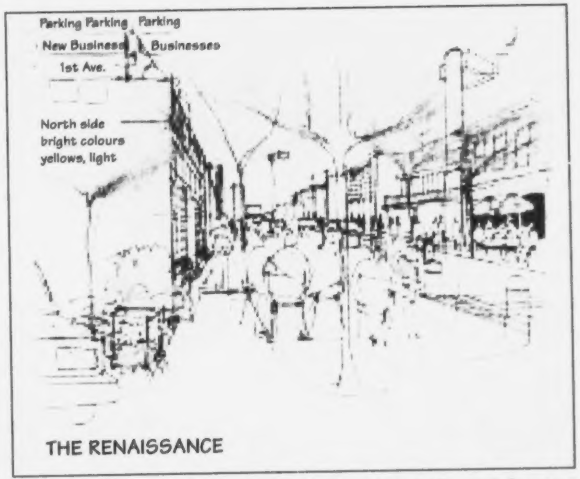
9.2 Concept Plan

9.2.1 Objectives

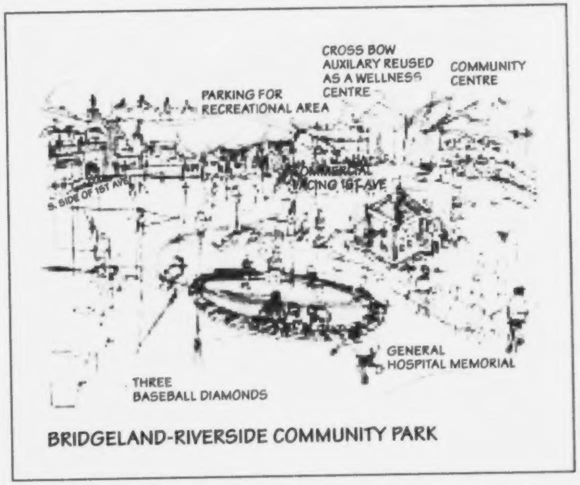
- “Achieve the objectives of the Calgary Transportation Plan in a manner appropriate to the local context.” (Terms of Reference)

- “Ensure development contributes to a sense of community, consistent with the goals of the Bridgeland-Riverside Area Redevelopment Plan.” (Terms of Reference)

The concept plan envisions a revitalized community that is infused with a renewed sense of purpose and energy as some 2,000-2,500 new residents make Bridgeland-Riverside their home. It envisions streets that are tree-lined, lively, safe, and interesting, convenient, and pleasant for everyone - the young, the elderly, the disabled. It is a community in which you can walk, cycle or take transit to work and for many other daily trips. 1st Avenue is a successful, busy retail street that provides goods and services needed by local residents but also draws customers from nearby communities and Calgary as a whole.


Parking Parking Parking
New Business
Businesses
1st Ave.
North side bright colours yellows, light
THE RENAISSANCE

Co-Design Fair Drawing #10 - 1st Avenue


CROSS BOW AUXILARY REUSED AS A WELLNESS CENTRE
COMMUNITY CENTRE
PARKING FOR RECREATIONAL AREA
S. SIDE OF 1ST AVE
COMMERCIAL FACING 1ST AVE
GENERAL HOSPITAL MEMORIAL
THREE BASEBALL DIAMONDS
BRIDGELAND-RIVERSIDE COMMUNITY PARK

Co-Design Fair Drawing #43 - A large park

A new 'heart' for the community is also envisioned - the relocation of the large park and the new community hall closer to the centre of the community brings them within walking distance of many more households. And the new community hall can be designed and built to serve the needs of the community more effectively than the existing hall is able to. In short, the concept plan envisions a new urban neighbourhood that is distinctive yet plays a strong role in helping to unite the entire community. Finally, it envisions the creation of a place that by virtue of the quality of its design and development and in the attention paid to detail, will set a new standard for urban redevelopment in Calgary.

9.2.2 Organizing Principles

The site is organized around a large central park which overlooks the Bow River Valley and has views of Downtown. A new community hall will be constructed here, providing a basis for an invigorated community association located at the heart of the community. Key organizing principles guiding the pattern of development are:

- Recognizing the site as a prime inner city neighbourhood with a broad range of community amenities and facilities
- Responding to the transit-supportive, intensification and sustainability objectives of the Calgary Plan
- Achieving a built form that responds to the large central park and the LRT station area and is respectful of existing development
- Ensuring that public systems are accessible, particularly to the park and the LRT station
- Consideration for the principles of urban safety and winter city design
- Creating a local street system that serves the site but discourages through traffic
- Defining and animating residential streets
- Providing housing consistent with livability, sustainability and environmental objectives
- Enhancing the commercial nature and pedestrian experience along 1st Avenue
- Establishing a public systems plan which integrates with the existing community.

9.2.3 Major Land Use Components

The Concept Plan casts an eye not only to the past but is grounded in the present and anticipates the future. It responds to the site's inner city location, proximity to Downtown and diversity of existing development. It is a plan that is fundamentally urban in character. The major land use components are shown in Figure 19 and described in the following sections.

- **Transit-Supportive Development (LRT Station Area)**

  Transit-supportive development refers to patterns of land use and the design of pedestrian routes, sidewalks and pathways that make transit a more convenient, accessible and efficient transportation choice for people. The area in the immediate vicinity

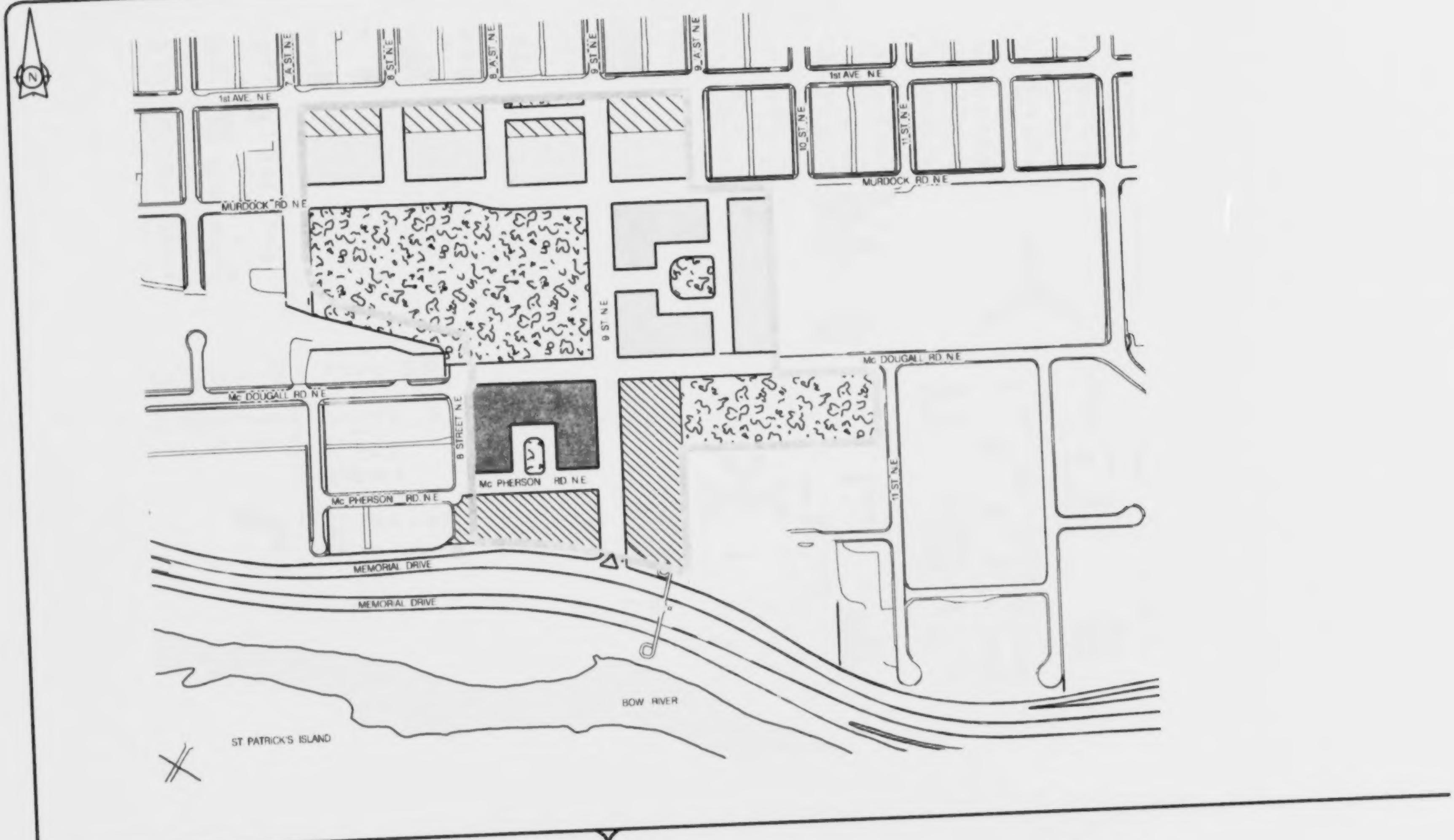

N
1st AVE. N.E.
7_A_ST_N.E
8_ST_N.E
8_A_ST_N.E
9_ST_N.E
9_A_ST_N.E
1st AVE N.E.
10_ST_N.E
11_ST_N.E
MURDOCK RD N.E
MURDOCK RD N.E
9 ST N.E
Mc DOUGALL RD N.E
Mc DOUGALL RD N.E
8 STREET N.E
Mc PHERSON RD N.E
Mc PHERSON RD N.E
11 ST N.E
MEMORIAL DRIVE
MEMORIAL DRIVE
BOW RIVER
ST PATRICK'S ISLAND
Site Boundary
Local Commercial And Mixed Use
Transit Supportive Mixed Use
Park
Multi-Family Resicential
4 - 6 Storey
4 - 7 Storey
7 - 8 Storey
0
50
100
200
metres

Figure 19 Bridgeland - Riverside

Conceptual Land Use Plan

May 2002

THE CITY OF CALGARY
PLANNING & TRANSPORTATION POLICY

\\work\work\plan\plans\arp\bridgeland\conceptual_landuse.dgn
DATE PLOTTED 02-MAY-2002

of the Bridgeland LRT station has the potential to accommodate a variety of development that would be transit-supportive, including medium-high density housing, office development, institutional and/or mixed use development. Further study is required, however, to determine the feasibility of office or mixed-use development.

- **Local Commercial - 1st Avenue**

1st Avenue is the prime public focus of the Concept Plan. It will be reinforced as the commercial centre of the community. Ultimately, 1st Avenue will become the hub of Bridgeland-Riverside but it will also remain as an area of transition. For example, just as the avenue subtly changes in density and streetscape from the neighbourhood to the north, it will also effect a transition in scale to a higher density to the south.

A mix of land uses is proposed for 1st Avenue with the emphasis on retail development at grade with two storeys of residential development above. This represents an extension of the local commercial zoning on the north side of the avenue and allows for retail development to occur on both sides of the street. The strategy is to concentrate retail development on the two blocks west of 8A Street in order to reinforce existing retail development on the north side of 1st Avenue and immediately to the west of 7A Street on the south side. A public plaza proposed for the block between 8A and 9 Streets

Retail with housing above

The public life of the street

will accentuate this area as a strong public gathering place and focal point for retail activity on the avenue.

Beyond these two blocks, it is unclear how much additional retail development can be supported. It is important, therefore, to allow for land uses and to encourage a built form on the two easterly blocks that are viable in the short-term but could convert to retail development over time. For example, street-oriented townhousing and live/work units would be suitable forms of development that allow continuous development along 1st Avenue to occur within a relatively short period of time.

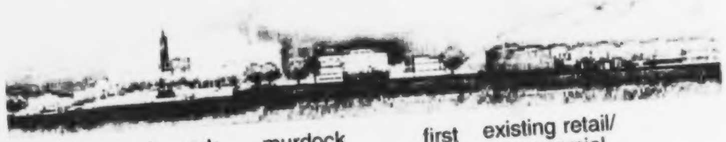
In addition, there may be potential for a limited amount of local commercial development in the immediate vicinity of the LRT station. Such retail development would be focused on providing convenience goods and services to transit riders or office workers (if a major office development were to occur here). The scale and orientation of such retail development would be such that it would not compete with businesses on 1st Avenue.

- **Public Parks and Open Space**

The cornerstone to the Concept Plan is the development of a large, central park south of Murdock Road which together with the new community hall will become the heart of the community. The escarpment lying to the west of the site would be extended into the park, grade

Large park 'framed' by housing

typical section



changes would be incorporated in a variety of forms (tobogganing hill, soccer field, tot lot, etc.), and the park is strategically placed in proximity to the activity of 1st Avenue. This park will play an important role in meeting the recreation and leisure needs of community residents.

The park will be framed by residential development on the north, east and south, ensuring that there will be "eyes on the park". To the west, views open up to the Downtown and the Bow River Valley.

The existing neighbourhood park (McDougall Park) will continue to be provided east of the development site on 9th Street and south of McDougall Road. It encompasses a seniors' park, playground and a picnic area.

Finally, a small ornamental park located east of 9th Street and south of Murdock Road will be developed in conjunction with the housing developments that will frame it. A second ornamental park is also planned to be developed within Block 9 (Figure 24). These parks will provide a visual amenity for surrounding residents and pedestrians and opportunities for passive recreation in a public setting.

In addition, these small parks will help integrate the redevelopment site into the larger community by enhancing the pedestrian environment, enriching the variety of public spaces and by creating block sizes that are more compatible with the existing development pattern than would otherwise be the case.

- **Residential**

A variety of multi-family development is encouraged throughout the site, including street townhouses, stacked townhouses, apartments, and 'live/work' units. Development will be characterized by an orientation to the street (i.e., ground floor units will have direct access to the street) and by building heights that are in the mid-range (3-8 storeys).

9.2.4 Urban Design Approach

The Concept Plan relies upon a solid approach to land use and development but also develops an approach to urban design that is intimately related to the intensity of development proposed. The approach taken relies upon the establishment of protocols or principles that are intended to ensure the creation of livable, pleasant urban spaces and to also ensure a good 'fit' with existing development on surrounding lands. To this end, the Plan introduces new building forms to the community.

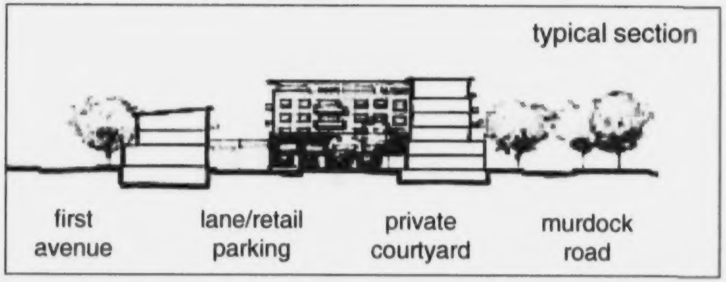
- **Built Form**

As discussed earlier in this document, there are several distinct character areas within Bridgeland-Riverside. This diversity poses one of the most significant challenges for redevelopment - how to develop a response to the existing land use and built form pattern that can help 'knit' the entire community together and yet anticipate the future. In part, the answer lies in the introduction of a new building type to the community. This building type is distinguished by its orientation to the street, its mix of housing unit types and land uses, and its height.

1st Avenue is the logical place for the new building form to be introduced. It is the transition from the existing patterns of low scale pedestrian development to a denser street that remains rich and complex at the pedestrian scale, and yet is an extension of the existing. Three urban design elements should become components in all new development within the BVC site. These elements will assist in establishing a new and more dense variety of housing that will both 'fit' with the existing patterns and revitalize the existing community.

The first element is the establishment of a consistent building base that will directly relate each building to the street. A variety of elements such as the use of different materials, numerous front doors, stoops, bay windows, other means of articulation, detailing, individual distinction, etc. will be used to establish a pattern of street front units and scale that respond to existing building patterns in Bridgeland-Riverside. This pattern will help focus activity onto the streets and increase the level of security and safety in the neighbourhood.

Massing of a 5-6 storey building



The second urban design element is to make a distinction between the 'base' of the building and the body and the top of the building. This will be accomplished by setting the upper storeys (above the 2 - 3 storey) back from the base of the building. This will reduce the visibility of the top of the building and its overall mass.

The third urban design element is the provision of street trees and the creation of a 'street wall' which clearly defines the public, semi-public and semi-private realms. This environment will be created by minimal setbacks so that buildings are close to the sidewalk (about 3 metres) and by ensuring that trees are planted in the boulevards.

- **Relationship between Built Form and Open Space**

One of the key organizing principles for the BVC site is the relationship that will be established between the open spaces and the built form. The Concept Plan arranges the building forms so that the public spaces will be defined and framed by the building edge and walls. For example, the large park will be enclosed on three sides by buildings that range in height from 6 - 8 storeys. The fourth side of the park is open and provides views of the Downtown and the Bow River Valley.

Development sites are defined by an open space system organized into an integrated network of paths and places including:

- large central park, including the Murdock Road Esplanade and 7A Street lookout
- 1st Avenue Plaza
- Meredith Square
- McPherson Square
- Seniors' Park.

9.2.5 Sustainability, Urban Safety and Winter City Design

Two major opportunities for sustainable development offered through redevelopment of the BVC site, are to use land efficiently and wisely by optimizing development

"Eyes on the street"

densities and to reduce dependence on the car. There are, however, other opportunities to create a more sustainable community. These include providing opportunities for passive solar gain, durable construction (concrete), stormwater management, building and energy technologies, fiber-optic communications, and increased energy efficiency.

Sustainable communities are livable communities and essential aspects of livability are public safety and security. The design of public spaces, parks, buildings, parking lots and other developments should incorporate the principles of Crime Prevention Through Environmental Design (CPTED). In this respect, the design and siting of new buildings should provide opportunities to oversee activity on the street, provide easy access to adjacent streets and allow clear views to parks and open space from the street.

Building a more sustainable community also means considering the impacts of climate on public environments, especially during winter months. The two most important factors to consider are sunlight access and wind protection. Building orientation, massing and height strongly affect access to sunlight. Landscaping and building form also affect wind patterns. These factors should be taken into account to ensure that public spaces are sunny and sheltered wherever possible. Opportunities for winter activities such as skating and tobogganing should be provided so that advantage can be taken of the positive aspects of the winter season.

Finally, a sustainable community is one that remains livable over a long period of time. The overall quality of development and the relationships between different activities (residential, working, recreational) are fundamental considerations in this regard.

9.3 Land Use Policies

The previous section outlined the overall logic and philosophy of the Concept Plan and described each of the major land use components. This section of the ARP amendment further elaborates on each land use component and provides the associated policies which will form the basis for subsequent development of the Outline Plan and Land Use Redesignation applications.

General

The following policies apply to all areas of the Concept Plan:

1. All development should exhibit a high quality of design, foster and support an attractive, interesting pedestrian environment, and respect and enhance the site's inner-city context. To this end, buildings should, wherever possible:

    - Front onto adjacent public streets
    - Be compatible with adjacent development in terms of massing and scale
    - Provide direct access to grade from first floor dwelling units

Table 1 Summary of Land Use Policy Areas

Policy Area	**Proposed Land Use Designation**	**Proposed Land Uses**	**Building Form**	**Max. Res. Density* (net acres)**
Transit-supportive Development	Direct Control (DC)	Residential, office, institutional, commercial	Up to 34 m	130 upa
Residential • North of Murdock Rd	Direct Control (DC)	Residential	Townhouse base, apartments above up to 6 storeys	100-120 upa
• South of Murdock Rd and north of McPherson Rd	Direct Control (DC)	Residential	Same as above up to 8 storeys	130 upa
Parks	PE	Parks and public open space	N/A	N/A
Local Commercial Mixed Use	Direct Control (DC)	Retail, commercial, office, residential	3 storeys	40-45 upa

**Maximum number of housing units per acre of land (i.e. on a building lot, excluding roads, parks, etc.)*

- Be oriented to promote the security of public spaces and 'eyes on the street'
- Incorporate a high degree of articulation and visual interest.
- Set upper storeys back from the base of the building in a consistent manner to be established in the Direct Control guidelines.

2. Wherever possible, buildings should be sited to optimize the benefits of solar exposure and reduce overshadowing effects on surrounding buildings and public spaces.

3. Encourage builders to take full advantage of opportunities for passive solar gain in their building design and to install water-saving fixtures and high energy-efficient heating and cooling systems in their developments.

4. Encourage and support alternative approaches to stormwater management for the site development that improve the quality of water discharged into the Bow River.

5. Each development should establish a hierarchy of spaces with clear distinctions made between public, semi-public, semi-private and private spaces.

6. Public, semi-public and semi-private spaces should have some degree of overlook from residents' homes.

7. The landscaping and design of yards adjacent to public streets and pathways should enhance the experience of walking down the street and provide definition of the boundaries between the public and semi-public realms.

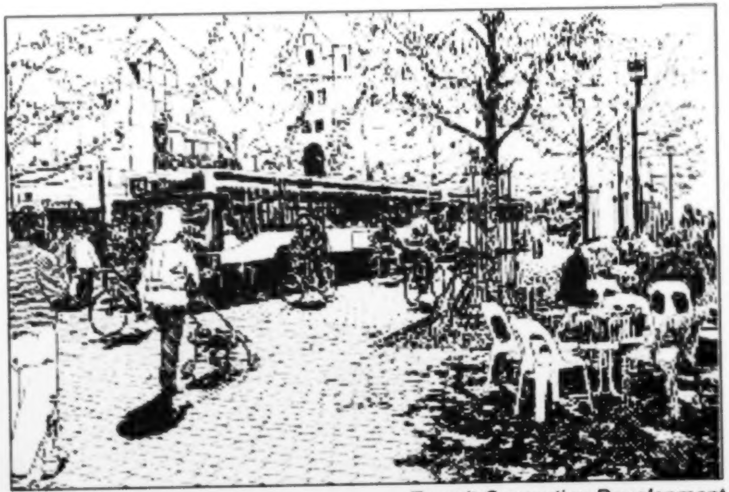
8. Parking and vehicular access should be designed to respect the pedestrian environment and to minimize disruptions to the continuity of pedestrian systems.

9. Rooftop mechanical equipment should be screened in a manner satisfactory to the Development Authority.

9.3.1 Transit-Supportive Design and Development

Objectives

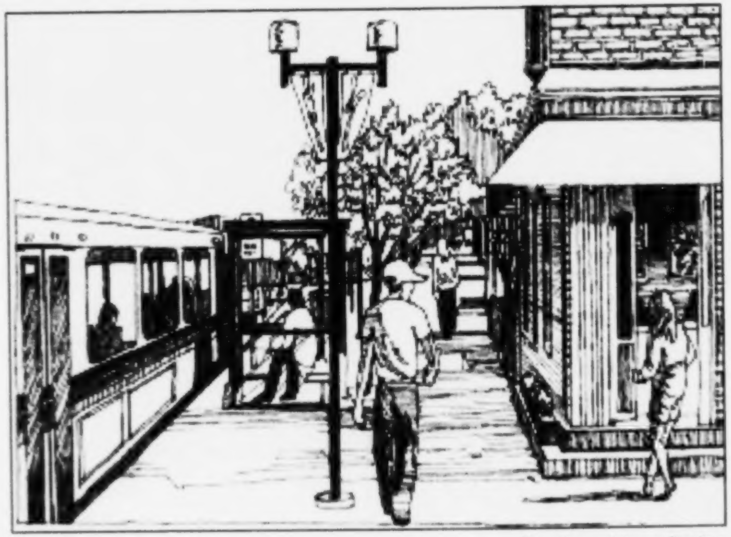
- "Encourage sensitive types of housing intensification" (Calgary Transportation Plan)
- "Encourage new housing close to transportation facilities and within mixed-use centres to support



Transit-Supportive Development

transit and pedestrian mobility choices." (Calgary Transportation Plan)

- "The transit system will offer Calgarians a reasonable alternative to auto travel by:
    - facilitating access to transit for seniors and people with disabilities
    - integrating transit with other modes of travel." (Calgary Transportation Plan)
- "To provide for the development of a land use pattern that will be better able to be served by public transit." (Bridgeland-Riverside Area Redevelopment Plan)



Sheltered transit stop

Two of the key aims of the Calgary Transportation Plan and the Calgary Plan are to increase land use efficiency and to support and enhance the use of transit. The design and development of the urban environment - especially in areas close to transit facilities - is a critical factor in being able to realize these aims. The BVC site is well situated to contribute to the achievement of these aims due to its proximity to the Downtown and its adjacency to the Bridgeland LRT Station (Figure 20). The community is also well served by the Route 9 bus which goes Downtown, to the University of Calgary, the 10th St Safeway and other locations of interest to Bridgeland residents.

Land use planning and urban design must work hand-in-glove with transit planning in order to ensure the effective operation of the transit system. Transit works best when there are a substantial number of people living and/or working within a 5 minute walk of the transit stop/station. Appropriate land use patterns must in turn be supported by a street, sidewalk and pathway system that is safe and convenient for pedestrians. Direct pedestrian routes are also necessary. Generally, there should be 'eyes on the street', sidewalks and pathways should be accessible and well-lit, and changes in grade should be gentle where possible.

One of the opportunities presented by redevelopment is to improve and enhance the physical environment in the immediate vicinity of the Bridgeland LRT Station. In particular, it is important to take the opportunity to remove the existing spiral ramp access to the pedestrian overpass

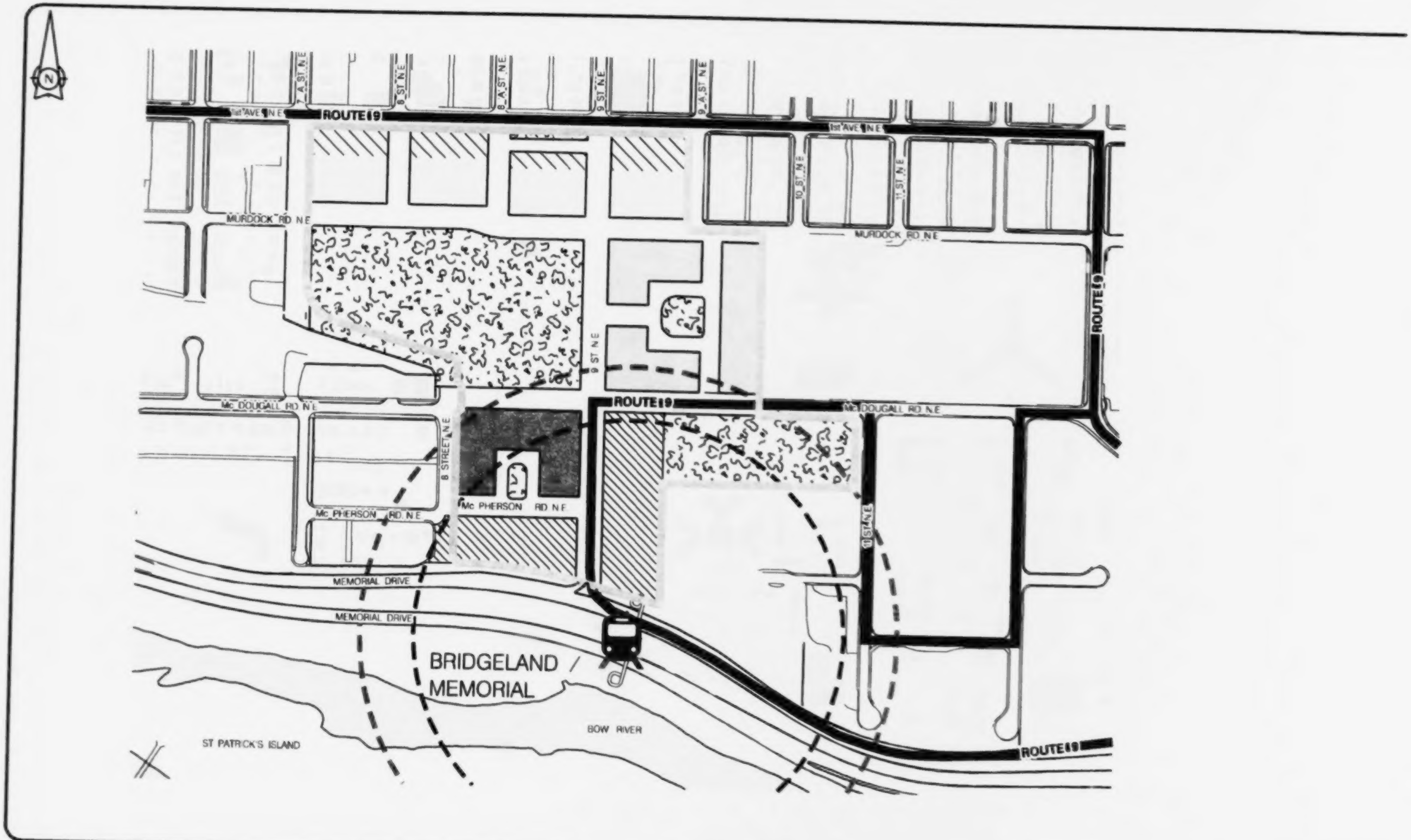

N
1st AVE N E
ROUTE 9
7_A ST N E
8 ST N E
8_A ST N E
9 ST N E
9_A ST N E
10 ST N E
11 ST N E
MURDOCK RD N E
Mc DOUGALL RD N E
8 STREET N E
Mc PHERSON RD N E
MEMORIAL DRIVE
BRIDGELAND / MEMORIAL
ST PATRICK'S ISLAND
BOW RIVER

Figure 20

Bridgeland - Riverside

Transit Service

May 2002

THE CITY OF CALGARY
PLANNING & TRANSPORTATION POLICY

\\work\work\plan\plans\arp\bridgeland\transit_service.dgn

DATE PLOTTED 02-MAY-2002

0 50 100 200
metres

▭	Site Boundary		Multi-Family Residential
▨	Local Commercial And Mixed Use	☐	4 - 6 Storey
▨	Transit Supportive Mixed Use	☐	4 - 7 Storey
▨	Park	■	7 - 8 Storey

🚆	L.R.T. Station
▬	Bus Route
◠	300 Metre (5 Minute Walk Distance)
◠	400 Metre

connecting to the LRT station and build a more convenient, more visible and less isolated accessible connection. Development of Block 10b (Figure 24) will provide the opportunity to integrate a new universally accessible connection, as well as the potential for a direct link into the building that will be constructed there. The new access to the pedestrian overpass should encourage pedestrians to use 9th St in order to increase pedestrian activity on the street and to help support any retail/ commercial development in the vicinity. The cost to replace the existing spiral ramp will be the responsibility of the landowner/developer.

Policies

1. Development will be distributed to take advantage of both the mainline bus route and the LRT service.

2. Develop a range of compatible land uses (e.g., residential/ commercial) within close walking distance of the Bridgeland LRT Station and mainline bus service on 1st Avenue.

3. Improve the connection between the feeder bus and the LRT station by removing the bus stop on Memorial Drive and relocating it onto 9th St.

4. Enhance safety of the LRT station area by providing active uses immediately adjacent to the station access and through physical improvements to the surrounding environment.

5. Dedicate a public access easement along the east side of Block 10b between the LRT station access and the west end of the Metropolitan Calgary Foundation developments. This easement should connect with the public access easement dedicated on the Metropolitan Calgary Foundation lands to provide a continuous pathway to the LRT station.

6. Improve physical access to Bridgeland Station. The developer of Block 10b will be required to submit a building design that incorporates a universally accessible connection to the new proposed building with the LRT bridge. The design of the improved access to the pedestrian bridge will be explored by the developer and The City of Calgary.

7. Provide direct pedestrian connections to bus stops and equip transit shelters with amenities designed to provide a comfortable waiting environment (e.g. heating and lighting and related amenities such as benches, route maps, bicycle storage facilities and passenger drop-off areas).

9.3.2 Residential

Objectives

- "Encourage sensitive types of housing intensification" (Calgary Transportation Plan)
- "Encourage new housing close to transportation facilities ..." (Calgary Transportation Plan)

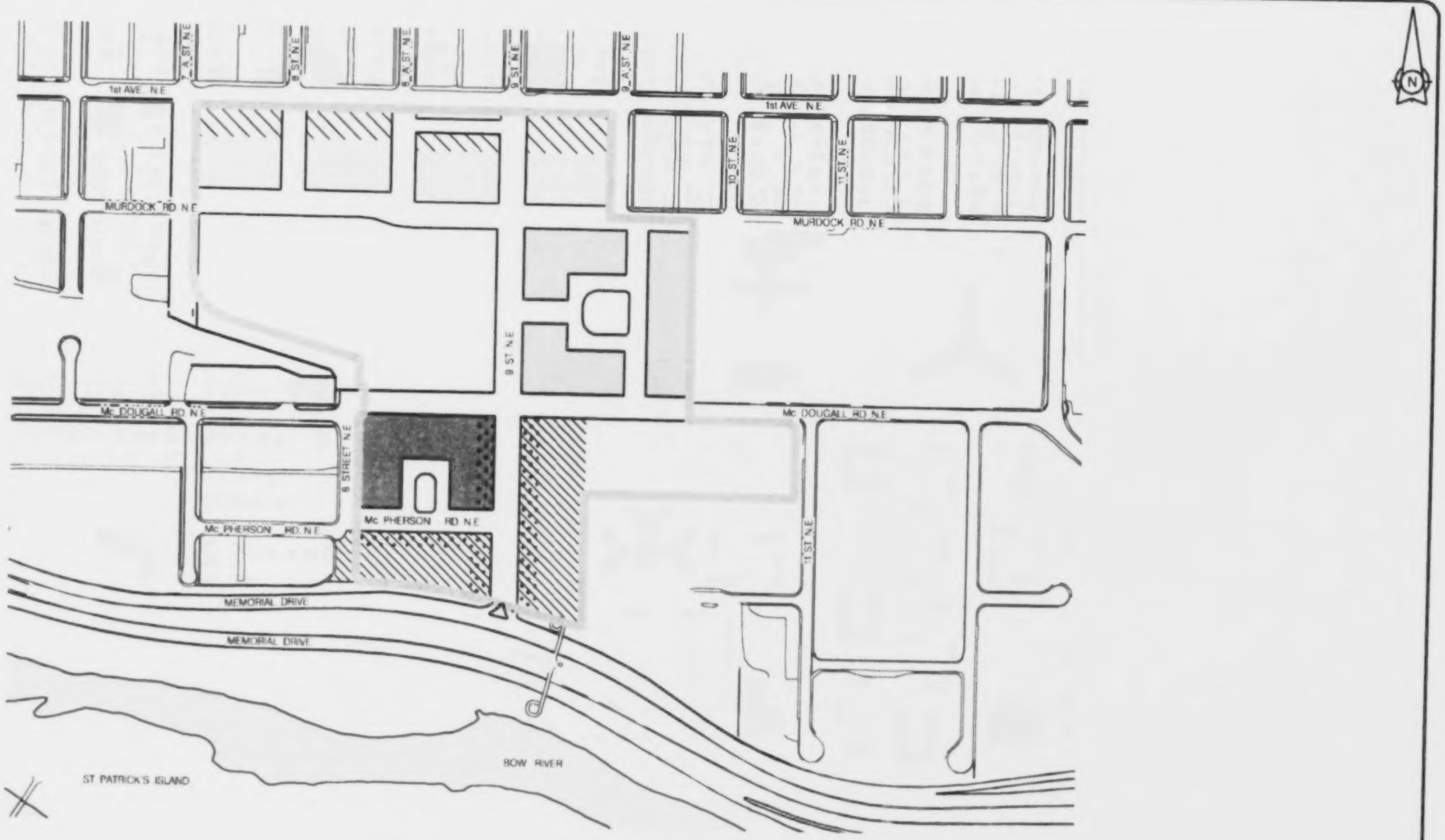
- "...increase residential densities in appropriate locations." (Bridgeland-Riverside ARP)
- "...provide opportunities for a wider range of residential alternatives for different age and income levels." (Bridgeland-Riverside ARP)
- "Explore opportunities for innovation in residential and mixed used development, including consideration of special needs and affordable housing." (Terms of Reference)

In short, these objectives relate to four key aspects of housing - location, housing type, physical form, and affordability. (Figure 21)

Location - The relocation of Riverside Park accomplishes two complementary objectives - it optimizes the distribution of open space within the study area and community and it allows housing and other types of transit-supportive development to be built in the immediate vicinity of the LRT station. In addition, a significant amount of new housing will also be built in close proximity to or on 1st Avenue so that bus service and 1st Avenue businesses will also be better supported.

Housing Type - New building forms are being proposed that incorporate street related housing at the base of buildings with apartments above. Townhouses are suitable for a wide range of households including, singles, young couples, empty nesters and families with children. In addition, in some locations, opportunities may be created for the owner of a townhouse to develop a 'secondary suite' or to develop a 'live/work' unit. The opportunity to pursue either of these options helps to extend the range of affordability for individual households. (See discussion under 'Affordability'). Over longer periods of time, these options also increase the flexibility with which households can respond to changing economic or family circumstances without having to leave their home or community. As such, the long-term stability of the community is also facilitated.

Street townhouses with apartments buildings above


1st AVE. N.E.
7 A ST N.E.
8 ST N.E.
8 A ST N.E.
9 ST N.E.
9 A ST N.E.
10 ST N.E.
11 ST N.E.
MURDOCK RD N.E.
Mc DOUGALL RD N.E.
8 STREET N.E.
Mc PHERSON RD N.E.
MEMORIAL DRIVE
BOW RIVER
ST PATRICK'S ISLAND
N

Site Boundary

▨ Local Commercial And Mixed Use
- Live Work
- Apartments Above 1st Storey

░ Live Work

▨ Transit Supportive Mixed Use

☐ 4 - 6 Storey

░ 4 - 7 Storey

▓ 7 - 8 Storey

Bridgeland - Riverside

Figure 21

Residential

May 2002

0 50 100 200

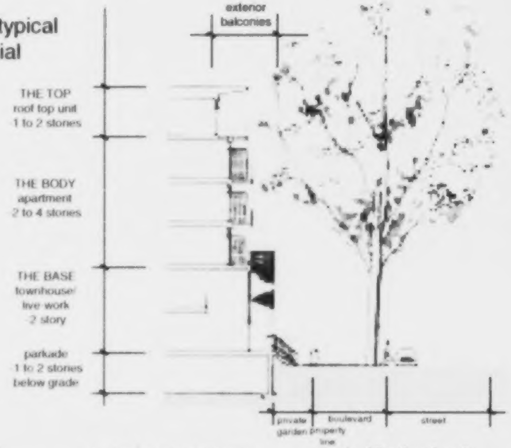
metres

THE CITY OF CALGARY
PLANNING & TRANSPORTATION POLICY

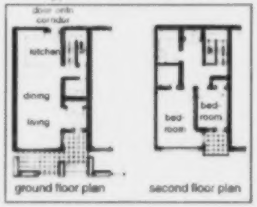
\\work\work\plan\plans\arp\bridgeland\residential.dgn
DATE PLOTTED 02-MAY-2002

Physical Form - The Concept Plan proposes to introduce a new building type into the community as described above. The residential component of this building type comprises a base of housing units with direct access to the street. The upper storeys of buildings would be set back from the building base of two or three storeys. Above the townhouses, apartments would be built with building heights ranging from four to eight storeys. The Direct Control guidelines of the Land Use Bylaw should establish a consistent set back for the upper storeys of buildings. In some locations, live/work units would be encouraged.

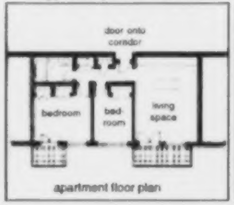
section through the typical multi-family residential building


exterior balconies
THE TOP
roof top unit
1 to 2 stories
THE BODY
apartment
2 to 4 stories
THE BASE
townhouse/
live work
2 story
parkade
1 to 2 stories
below grade
private garden
property line
boulevard
street

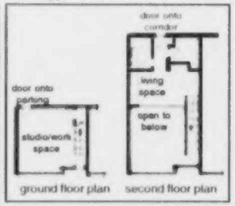
typical townhouse unit


door onto corridor
kitchen
dining
living
bed-room
bed-room
ground floor plan
second floor plan

typical apartment unit


door onto corridor
bedroom
bed-room
living space
apartment floor plan

typical live/work unit


door onto corridor
door onto parking
studio/work space
living space
open to below
ground floor plan
second floor plan

The emphasis on landscaping the boulevards with street trees and the establishment of minimal building setbacks has implications for the landscaping of front yards. In many cases, it may not be possible to plant trees in front yards. This implies the need for the Development Authority to consider deferring some of the on-site tree requirements to the surrounding boulevards. Nonetheless, on-site landscaping must be to a high standard that contributes to the overall quality of the project.

Affordability - In Calgary, the demand for affordable housing, both market and non-market, is high. For purposes of the following discussion, 'affordable housing' refers to housing that is available to households with low to moderate incomes which does not require them to pay more than 30 percent of their gross income for housing. In this context, affordable housing could be provided through the private, non-profit and/or public sectors. In addition to meeting basic human needs, affordable housing supports social diversity and offers opportunities to adapt to changing lifestyles.

'Non-market housing' refers to any social or special needs housing which receives some government funding in order to support individuals or families who cannot afford to pay market rent.

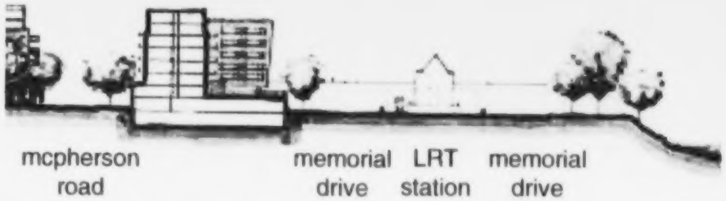
The City of Calgary is prepared to considered partnerships/joint venture proposals with non-profit organizations, other levels of government and the private sector to deliver affordable housing within the study area.

Well-designed affordable housing projects that contain a mix of market and non-market units, integrate well with the surrounding area, and cater to different target groups, will be encouraged. Such projects may include co-operatives, co-housing, and other housing initiatives from the public, private, and non-profit sectors.

A notable amount of non-market housing already exists in the community adjacent to the study area. In order to ensure an appropriate balance between market and non-market housing within the community as a whole, greater emphasis will be given to the provision of affordable market housing that is targeted to households with incomes that fall below the median household income for the city.

A potential synergy exists between the desire to promote use of the LRT and the provision of affordable housing. The LRT station area south of McDougall Road is a logical place to promote and encourage the provision of affordable market housing geared for singles and couples.

typical section



Policies

1. A variety of townhouse and apartment developments will be encouraged and facilitated in order to expand the range of housing choices within the community.

2. Each development and dwelling unit should be designed with consideration of privacy, territoriality, individuality and identity, and access to sunlight for habitable rooms and private amenity spaces.

3. Residential buildings will be oriented to the street in order to enhance the experience of the pedestrian, to enhance the safety of the community and the housing project, and to facilitate opportunities for social exchange.

Attention to detail, individual unit identity, front gardens

4. Building setbacks from the street will be minimized in order to establish an urban development character and to bring buildings closer to the sidewalk and pedestrians.

5. After the second or third storey, buildings should be setback to reduce the visibility of the upper storeys from the street. The Direct Control guidelines should establish the manner in which the setbacks will be treated.

6. Appropriate levels of detailing, building articulation, and doors on the street will be strongly encouraged.

7. For new housing developments that would be located immediately adjacent to existing R-2 low density residential development, the maximum building height shall not exceed 4 storeys in order to ensure an appropriate transition.

8. Particular attention will be paid to the design and landscaping of front yards to ensure an appropriate edge is created to the street and that there is a clear distinction between the public, semi-public and private realms. In this respect, the use of low fences and hedges or other suitable means of marking the boundary between the public and private realm will be encouraged.

9. The Development Authority may consider deferring some of the Land Use Bylaw requirements for on-site trees to adjacent boulevards. To maintain the emphasis of providing street trees in this area, the developer will, in general, be required to provide boulevard trees. Notwithstanding any on-site relaxations, site landscaping is to reflect a high quality throughout, with the developer providing as many trees as a site can reasonably accommodate.

An emphasis on street trees

10. When site landscaping is located on the roofs of parkade structures, a depth of soil shall be provided that is sufficient to support the growth of healthy vegetation. Alternative design solutions, such as corner cuts to the parkade base should also be explored, where appropriate. A qualified landscape architect should be hired by the site developer to ensure proper landscape design is achieved.

11. Parking and vehicular access should be designed to minimize impacts on the pedestrian environment in accordance with the following:
    - access to underground parking garages should be from the side street, wherever possible;
    - driveways should be as narrow as possible, in keeping with the *Standard Specifications for Street Design*. To facilitate narrowing of driveways and a reduction in the number of driveways, consideration should be given to shared access points;
    - consideration should be given to textured and/or patterned paving treatments for driveways;
    - landscaping should be a component of the design of the driveway area and should not create a visibility or safety problem;
    - any surface parking that is provided should only be provided at the rear of buildings so as to provide continuous street development.
12. Encourage the development of affordable housing that is available on an ownership or rental basis and that is affordable to low, middle and moderate income groups.
13. The City, in its role as landowner, is prepared to participate in partnership/joint venture proposals to deliver affordable rental housing, subject to budget considerations and partnership arrangements. A minimum of 100 affordable and/or non-profit units oriented to families with children will be pursued, with an impact report through the Calgary Planning Commission and the Affordable Housing team.
14. Affordable housing proposals should meet the following criteria:
    - the development should be well designed and integrate well with development in the surrounding area;
    - housing units should be designed to meet the long-term needs of the target groups (e.g. disabled, families, seniors);
    - the development should represent a mixed model approach, offering both market and non-market housing units;
    - rents should be retained at affordable levels on a long-term basis.
15. The provision of affordable market housing will also be encouraged and facilitated by:
    - considering the option to allow townhousing units the opportunity to divide into two suites (one larger unit and a 'secondary' unit), provided sufficient parking is available on site for the additional potential units.

Playing field

9.3.3 Public Parks and Open Space

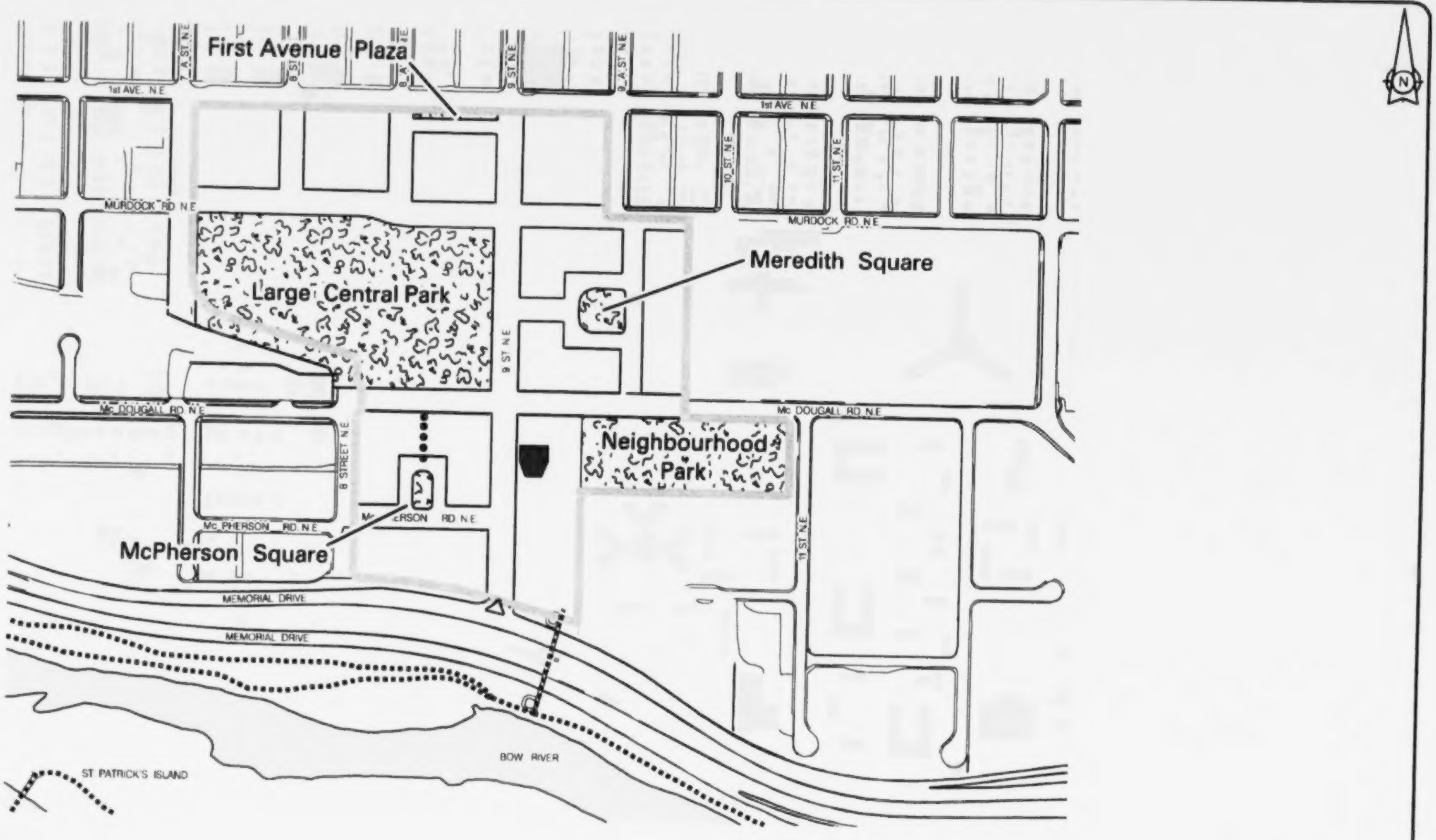
Objectives

- "...optimize the distribution of open space in relation to the surrounding community, while ensuring that the quality of facilities and amount of open space is equal to, or better than, that currently in place." (Terms of Reference)
- "Investigate the feasibility of providing a commemorative area which recognizes the contributions of the Calgary General Hospital and its role within the city." (Terms of Reference)

One of the most significant changes to be implemented during the redevelopment process is the relocation of Riverside Park to a more central location within the community (See Figure 22). As previously mentioned, the relocation of the major park accomplishes two complementary objectives - it optimizes the distribution of open space within the community and it frees up land adjacent to the LRT Station for transit-supportive development.

The benefits of the park relocation to the community are numerous. First, the new park will be within walking distance of many more households. Second, it ensures that the new views to the river valley and Downtown can be enjoyed by all community residents and Calgarians.

A public garden/square


First Avenue Plaza
Meredith Square
Large Central Park
Neighbourhood Park
McPherson Square
1st AVE. N.E
1st AVE N.E
7 A ST N.E
8 ST N.E
8 A ST N.E
9 ST N.E
9 A ST N.E
10 ST N.E
11 ST N.E
MURDOCK RD N.E
Mc DOUGALL RD N.E
8 STREET N.E
Mc PHERSON RD N.E
MEMORIAL DRIVE
BOW RIVER
ST PATRICK'S ISLAND
N
Site Boundary
Park
Regional Pathway
Potential Public Access /Pathway

Bridgeland - Riverside

Figure 22

Parks And Open Space

May 2002

0 50 100 200
metres

THE CITY OF CALGARY
PLANNING & TRANSPORTATION POLICY

\\work\work\plan\plans\arp\bridgeland\parks_openspace.dgn
DATE PLOTTED 02-MAY-2002

Third, it has created the opportunity for the community to reconsider the programming of its park space so that it can better meet the needs of local residents and other users of community facilities. Fourth, in conjunction with the relocation of the major park, a new community hall and outdoor pool/water feature will be built on the south side of Murdock Road. Fifth, the park will no longer be impacted by noise due to the high traffic volumes on Memorial Drive.

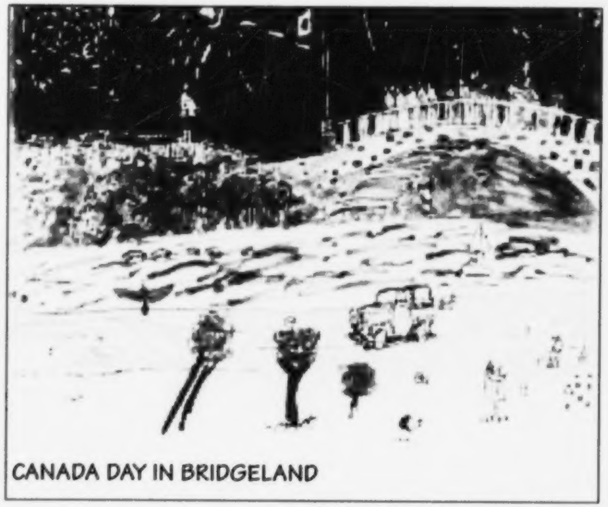
Park space will also continue to be provided at the east end of the study area (including McDougall Park), and in several smaller parks. Finally, a plaza will be created on 1st Avenue on the block between 8A and 9th Streets. The purpose of this plaza is to provide a small scale public gathering place that reinforces retail/commercial development, supports and enhances pedestrian activity on the street, and adds visual interest, a central focus and a distinct character to the street.

It is noted that the Concept Plan proposes that some of the parking requirement for the community hall and park facilities be accommodated on the street. This approach, in essence, increases the amount of park space available to the community for recreational purposes. It is also noted that not all of the open space lands may be dedicated as municipal reserve because of the restrictions on use stipulated under the provisions of the Municipal Government Act, 1995. In conclusion, the amount of park and open space that will be provided through redevelopment of the BVC exceeds the amount in the study area prior to redevelopment (4.17 ha). The quality of the space provided and the range of recreational activities provided will also better meet the needs of the existing community as well as the new residents than retention of the existing facilities would be able to.

• Community Hall

The Concept Plan proposes that the existing community hall site and outdoor pool be redeveloped for housing and other transit-supportive uses and that a new community hall and outdoor pool/water feature be constructed on the new major park site. A memorandum of agreement will be signed between The City of Calgary

Mature grove of trees, east of the existing community hall



Co-Design Fair Drawing #29 -
Watching fireworks from the large park

and the Bridgeland-Riverside Community Association (BRCA) detailing the arrangements for the hall relocation and construction of a new facility. The BRCA will continue to operate from its existing building until the new facility is available for occupation.

- **Park Space Programming**

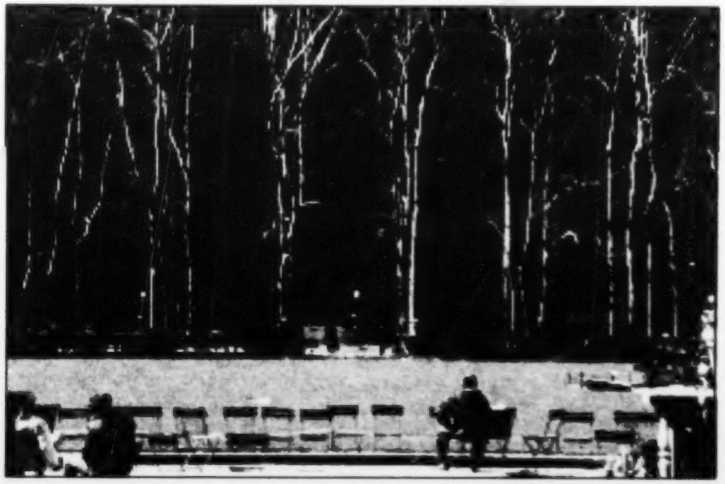
The relocation of the large park to a more central location and adjacent to future housing developments implies that the new park will have a more local focus than Riverside Park had. The location, configuration and topography of the new park will support a greater range of activities and park environments. The park will be developed as a series of terraces in response to the significant changes in grade that occur between Murdock Road and McDougall Road. For example, a large playing field (soccer) will form the central 'platform' of the park. Another terraced area will be created at the west end of the site and may accommodate a variety of uses such as tobogganing in winter and informal picnic, play field and amphitheatre in the summer. The east side of the park can also accommodate a variety of uses and may be programmed for more structured recreation uses (e.g., outdoor pool/ water feature, playground, basketball hoop, etc.).

The boundaries of the park will also establish a variety of environments facilitating a range of activities. For example, 7A St will be closed about one-half block south of Murdock Road so that the roadbed can be renaturalized and integrated into the park, thereby connecting the escarpment and existing pathway into the new park. The esplanade bordering the park on Murdock Road will offer opportunities for walking, sitting, overviewing and spectating in a more formal environment with views of the Downtown as a backdrop. The east side of the park borders 9th St and will offer pedestrians an interesting, varied, pleasant, tree-lined walk to the LRT station in one direction and to 1st Avenue in the other direction.

The existing neighbourhood park (McDougall Park) of approximately 1.16 ha (2.87 ac) will continue to exist east of the development site on 9th Street and south of McDougall Road. This park encompasses the existing seniors' park, a playground and picnic area.

The small ornamental parks, including the 1st Avenue plaza, form integral components of the open space system. For example, they add interest and variety to walking and cycling routes and create places to meet friends and neighbours and enjoy the public life of the street, etc. Although, these spaces serve important public functions, their success depends to a high degree on how well they relate to the immediately adjacent uses in terms of both function and design.

A new section of the regional path will be constructed on a public easement located on the east side of blocks 10A and 10B and along 9A Street, connecting the regional path between Memorial Drive and 10th Street.



Another park 'framed' by buildings

Linkages to the regional pathway system will be improved with the provision of pathways through the central park and the development of the street system, providing direct pedestrian and cycling links to the existing street network. In addition, consideration should be given to identifying the provision of a new pedestrian bridge to St. Patrick's Island in The City's capital budget for park facilities. The main benefit such a facility would have, is the reduced commuting time for pedestrians and cyclists bound for Downtown. It will also enhance the recreational use of the pathway system. As the population in this area continues to grow, the demand for such a facility is also anticipated to grow.

- **Calgary General Hospital Commemoration**

The new large park is located where the hospital buildings formerly stood on the site. Thus, the Concept Plan offers the potential to commemorate the location of the Calgary General Hospital in a variety of ways. Public input *regarding an appropriate way to commemorate the* hospital was sought during open houses held during the planning process. The results indicate that the public favors approaches that are modest in nature and located adjacent to or within the large central park.

Policies

1. The parks and open space should be designed to provide a diversity of recreational and landscape treatment, from urban/refined to natural areas and less planned/structured areas.

2. Public parks and open space should be appropriately located within the study area. The major components include the following as shown in Figure 22:

   - A central park of approximately 3.28 ha (8.10 ac) will be provided and should be configured to accommodate active and passive recreational use.
   - A neighbourhood park of approximately 1.16 ha (2.87 ac) will be provided at the east end of the study area.
   - One small ornamental park will be provided (approximately 0.14 ha in area) east of 9th Street and south of Murdock Road.
   - A small ornamental park (approximately 0.04 ha) will be built as a central feature of 1st Avenue that serves as a public gathering place and enhances the vitality of the avenue. This park will be subject to a maintenance agreement with the adjacent landowners and/or the local business community.
   - A third small ornamental park (approximately 0.05 ha) will be provided in conjunction with the development of McPherson Square. It should connect visually to the large central park, be designed to expose housing units to sunlight, and encourage optimal street frontage for townhouse units.

Parks can provide a variety of recreational opportunities

3. Parks should be designed to be durable, particularly with regard to the size of plant materials, types of landscapes and building materials and construction details. Park design and construction should be consistent with the *Design Development Guidelines and Standard Specifications Landscape Construction (Guidelines).*

4. Public parks and open space components of the study area should be located, sized and configured to create spaces that are functional, safe and flexible. Detailed design and development plans for each of the parks will be prepared by the Developer in consultation with City of Calgary Park Development and Operations, other City business units as appropriate, and the Bridgeland-

Riverside Community Association. Such plans should address project design, landscaping, performance standards and maintenance. Issues related to visibility, access, use, lighting, safety and security, seating, solar exposure and so forth should also be examined. Third party contributions are required for the maintenance of all park lighting and other unique design elements (e.g. fountains, gazebos, etc.).

5. The design of parks and the detailing of pathways, benches, etc. should take into account their use during all seasons of the year.

6. All parks and open space should be designated as PE as part of the land use amendment process to reflect their future use as open space.

7. The configuration and design of parks and open space should respect and reinforce views and linkages to streets and other public spaces. Public spaces should be visible, safe, and designed to be sensitive to surrounding areas.

8. The street, sidewalk and pathway system should be designed as a barrier-free, integrated system, providing links to the nearby regional pathway and enabling residents to walk, jog and cycle safely throughout their community.

9. Where appropriate, parks and open space should be designed for both active and passive uses and should reflect the needs and preferences of local residents (existing and new). The spaces should also reflect and reinforce the character of the surrounding area and accommodate the anticipated activity and intensity of use.

10. A community stewardship role for the protection and shared management of parks and open space within the community should be promoted and supported through programs such as Adopt-a-Park, Adopt-a-Tree, the Planting Incentive Program, and the Greening of Calgary. It is noted that in some cases special maintenance funds and/or operating agreements may be extended or required (e.g., outdoor pool).

11. In addition to the provision of new planting, existing trees within the study area should be retained and/or relocated onto the new public open spaces, wherever possible. Where relocated trees are provided on public lands, maintenance must be addressed to the satisfaction of City of Calgary Park Development and Operations and their location shall be co-ordinated with Engineering Services.

12. Special consideration should be given to the protection of trees during the construction phases of redevelopment. Developers, builders and trades people will be encouraged to undertake effective tree and root protection practices. Public trees are subject to the provisions of the Parks Bylaw.

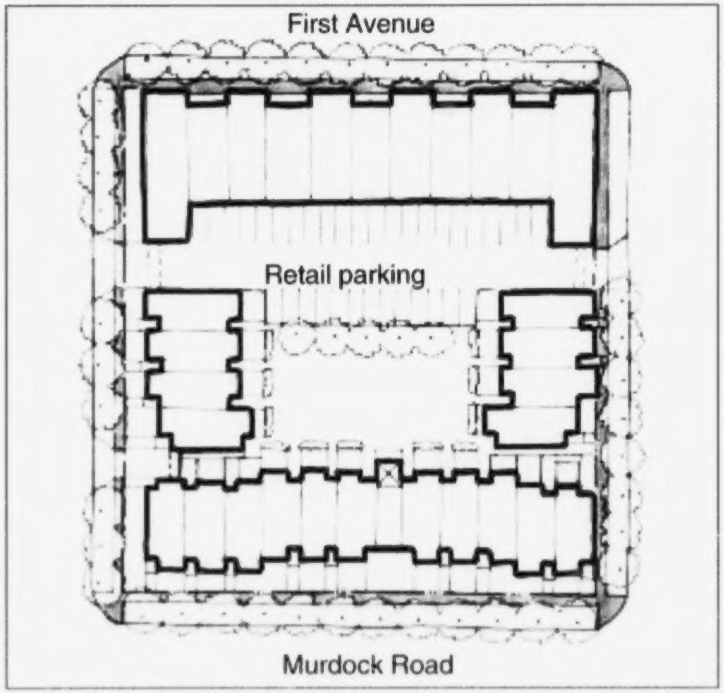
13. Consideration should be given to including the provision of a new pedestrian bridge to St. Patrick's Island in The City's capital budget for park facilities.

9.3.4 Commercial/Retail Development

Objectives

- "Explore opportunities to enhance the viability of 1st Avenue businesses."
- "Explore opportunities for innovation in residential and mixed-use development ..."

The concept plan proposes two locations for additional retail, commercial and office development - an extension to retail/commercial development on 1st Avenue and in the LRT station area. Small-scale retail/commercial development that would complement existing development and serve the needs of local residents such as bookstores, coffee shops, small restaurants, speciality stores, arts and crafts stores, etc. should be encouraged on 1st Avenue. Retail/commercial development in the vicinity of the LRT Station should focus on the convenience needs of transit users and nearby residents, including seniors and office employees, should significant office development occur in this area.



Potential building footprints - retail on First Avenue, housing on Murdock Road

9.3.4.1 1st Avenue

Retail street with housing above

Redevelopment and the new population it will bring to Bridgeland-Riverside represents a first step towards a revitalized 1st Avenue. Currently, commercial development on 1st Avenue is discontinuous. The strategy to revitalize the avenue as a commercial street is to encourage further commercial/retail development consistent with existing and potential commercial development on the north side of 1st Avenue and to concentrate new development in the two blocks to the west of 8A St. A wide variety of uses including live/work units, small scale institutional, offices, shopping, restaurants, arts and cultural activities, and entertainment will be encouraged. Commercial and retail goods and services that are focused on serving the needs of local residents will be encouraged.

The building form that will characterize development on the south side of 1st Avenue will complement existing development. Heights of 3 storeys will be encouraged with retail/commercial development provided at grade and office or residential above. Development at the street level will be similar in form to elsewhere in the study area - it will be street-oriented, well detailed, and building facades will be broken into small units or 'bays'.

A focal point for 1st Avenue will be developed on the block between 8A and 9th Streets in the form of a public plaza. The purpose of this plaza is multi-fold - to provide an interesting, attractive, comfortable public gathering

Pedestrian-oriented shopping street

place, to establish and reinforce a unique character and identity for the avenue, and to enhance the vitality of 1st Avenue. (Refer to Section 9.3.3, Parks and Open Space).

The retail area may extend along 1st Avenue to 9th St once confidence has been established in the viability of further retail development without jeopardizing existing development. The two easterly blocks may develop with a mix of residential and live/work units at grade with additional housing on the two storeys above grade. At a later date, these units could convert to retail/commercial space.

Policies

1. Encourage and reinforce commercial/retail development on 1st Avenue that is oriented to the needs of local residents, and is small scale, diverse and varied.

2. Enhance the pedestrian environment along 1st Avenue between 7A and 9A Streets.

3. Integrate new developments with existing businesses in a manner that complements existing businesses and is consistent with Policy 4.1 (1995 ARP).

4. Permit maximum heights of 3 storeys on 1st Avenue in accordance with Direct Control (DC) guidelines to be developed for the south side of the avenue within the study area. The DC guidelines should establish a setback for the upper portions of the buildings.

5. Create a public focal point for the community and 1st Avenue, such as a public plaza, on the block between 8A and 9th Streets.

6. Approve land use districts which permit the conversion of at-grade residential units to retail units, and vice versa, on 1st Avenue.

7. Loading zones for commercial/retail development should be located on site at the rear of the buildings.

9.3.4.2 LRT Station Area

One of the key objectives of redevelopment for the site is to take full advantage of the presence of Bridgeland LRT Station and encourage more ridership of the C-Train. Providing development in close proximity to the LRT station is one of the most significant changes proposed in the redevelopment plan that will have major benefits on LRT ridership. There may be the potential for office/institutional development in the order of 23,225 - 27,870 m^2 (250,000 - 300,000 sq. ft.) adjacent to the LRT station on Blocks 9 and 10b (Figure 24).

If office/institutional development of this magnitude were to be attracted to this site, the employees could support some retail/commercial development at grade. They would also support 1st Avenue restaurants and may take advantage of community programs and park space. This mix of uses - office/institutional with supporting retail and commercial development and with housing development on the north side of McPherson Road represents an ideal mix of uses adjacent to the LRT. Further, office/institutional development adjacent to Memorial Drive would buffer residential development from traffic noise generated on the expressway.

Bridgeland LRT station and pedestrian ramp

Policies

1. Continue to explore the feasibility of office/institutional development in the vicinity of the LRT. In the event that significant office/institutional development is determined to be feasible and appropriate, architectural design guidelines should be prepared to ensure that the design of the building(s) responds sensitively to the residential development in the immediate vicinity. The guidelines should address matters such as compatible building

materials, architectural detailing, extent and types of glazing acceptable, street presence, and building character.

9.4 Parking

The Concept Plan proposes that parking requirements will be handled primarily through on-site parking structures supplemented, in some instances, by surface and street parking.

Given the uncertainty around the potential for parking issues to emerge in the 1st Avenue-Murdock Road area, it would be appropriate to monitor the parking situation in the early stages of development. If problems arise that cannot be readily resolved, a parking study should be conducted so that a thorough analysis can be undertaken. The study should investigate the feasibility of on-street parking, need for metered parking, desirability of a public parking lot, and potential for a cash-in-lieu policy. The study would need to examine parking issues for both sides of 1st Avenue and include restaurants, retail businesses and the community hall and large park and the demand for parking generated by each of these developments.

General

The following policies apply to all areas of the Concept Plan:

1. With the exception of parking for retail/commercial development, parking is encouraged to be provided underground.

2. Underground parking should be well-lit and ventilated.

3. Parking entrances should be integrated into the building or landscape, and exposed walls should be architecturally treated. Good visibility should be provided for vehicles at access points to enhance the safety of pedestrians and the security of the building.

4. In the event that surface parking is provided, it must be located at the rear of the building in order to ensure a continuous built edge along the street.

5. A parking and traffic operations management strategy should be prepared for the commercial/retail development on the south side of 1st Avenue and submitted to the Calgary Roads Business Unit in conjunction with the development permit for the first commercial/retail building. The strategy should address issues related to parking requirements for commercial, retail and restaurant development within the study area, such as the feasibility/desirability of shared on-site parking arrangements, potential demand for on-street parking, traffic flows between sites, and other issues identified by the Calgary Roads Business Unit.

Underground parking

9.4.1 Residential

Policy 3.7 (1995 ARP) establishes that multi-family developments should provide 1.25 parking stalls per unit which is greater than the minimum standard of 1.15 set in Land Use Bylaw 2P80. This policy was created in response to problems that occurred because of the demand for on-street parking which were present when the hospital was operating. The Concept Plan supports this approach for residential development north of McDougall Road. where the market will readily provide this amount of on-site parking.

South of McDougall Road, a number of factors suggest that a slightly different approach would be appropriate. This area of the Concept Plan is the most likely to attract affordable market housing. In addition, it is in the immediate vicinity of the LRT Station. Provision of on-site parking and unit size are two of the cost factors that increase the price of housing. Therefore, it would be appropriate to reduce the on-site parking requirement for smaller units located south of McDougall Road.

Policies

1. Parking for residential projects should be secure, accessible and adequate for the needs of residents and visitors.
2. Parking for residential projects will be encouraged to be provided underground.
3. Require 1.25 on-site parking stalls per unit for housing development located north of McDougall Road.
4. In the event that surface parking is provided, it must be located at the rear of the building in order to ensure a continuous built edge along the street.
5. Require 1.15 on-site parking stall for housing development located south of McDougall Road in accordance with the minimum requirements of Land Use Bylaw 2P80.

9.4.2 Retail/Commercial

Retail/commercial development in this area creates a dilemma when it comes to parking. Small-scale retail development relies upon conveniently located surface parking (provided either on-site or on the street) in order to be economically viable. As well, retail development on 1st Avenue needs to be concentrated and provide a continuous street frontage in order to provide an appropriate environment for pedestrians and potential customers. This reduces the amount of space available for on-site surface parking. Traditionally, inner city retail development has relied on street parking to augment the on-site supply. Even so, finding sufficient parking for restaurants is a challenge under such circumstances.

Policies

1. Parking for retail/commercial development should be provided on-site at the rear of the buildings or may be provided underground. On site parking may be supplemented by on-street parking to the satisfaction of the Approving Authority.

9.4.3 Community Hall

Another issue is the most appropriate way to provide sufficient parking for the new community hall and central park. Traditionally such parking is provided on-site and the existing community hall meets its parking requirement in this way. However, the context for the new park will be different. It will be within walking distance of many households and it will be surrounded on four sides by streets. In addition, the interior of the park will be highly visible from surrounding residential development and pedestrians walking on adjacent streets. As such, the aesthetics of the park development are an important consideration. Given these circumstances, it is appropriate to consider the use of on-street parking to augment the supply of parking that can be provided on-site in an appropriate and aesthetically pleasant manner. Also, given the emphasis the Concept Plan places on creating a pedestrian-friendly street environment and the desirability of calming traffic, allowing and even encouraging on-street parking would be appropriate in this setting.

Accepting the use of on-street parking in partial fulfillment of parking requirements is consistent with the inner city context and with sustainability objectives. In this respect, the amount of space dedicated to car use is reduced, redundancy is decreased and the amount of impervious surface area is decreased. The potential for 8th and 8A Streets to be developed as one-way streets with angle parking on them should be explored, as an additional source of parking. These stalls could be metered. In addition, angle parking is proposed on Murdock Road in order to support community hall and park facility functions.

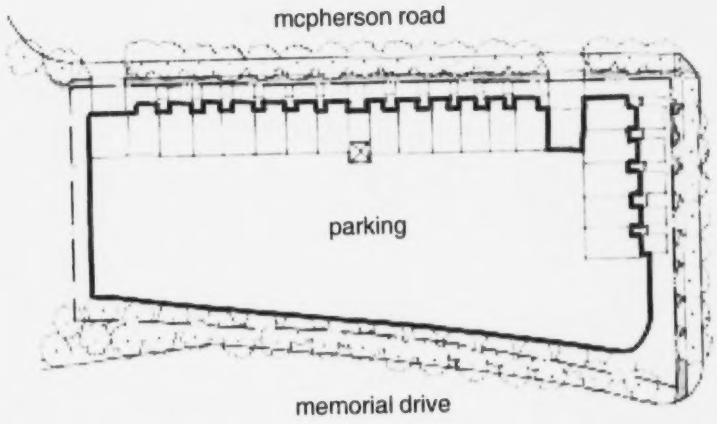
Policies

1. The Development Authority shall require a portion of the parking stalls to be provided on-site and is encouraged to relax the remaining stalls required for the community hall and large park after taking into account the availability of on-street parking on the four sides of the park.

9.4.4 Office/Institutional Uses

Parking for potential office or institutional development in the vicinity of the LRT station poses another set of challenges. Due to the high water table in this area, it may only be possible to build parking structures half a level below grade. This would have a negative impact on the pedestrian quality of adjacent streets unless the parking structures are screened from the street by constructing retail/commercial or live/work space in front of them. This approach addresses not only aesthetic concerns but also enhances the safety of the urban environment by placing active uses overlooking the street.

typical site plan



Policies

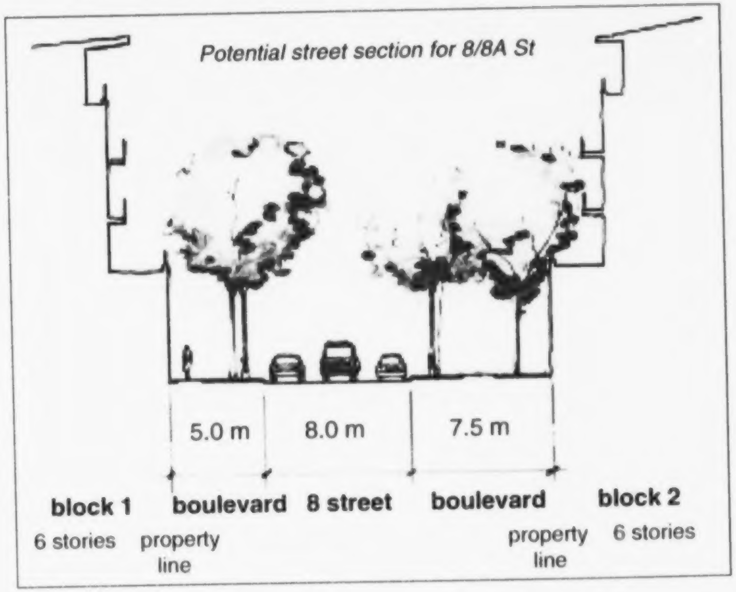
1. Parking for potential office/institutional development in the vicinity of the LRT station should be provided on-site in structured parking lots. Parking shall be screened from the street by placing retail/commercial or live/work development at-grade in front of the parking structure.

9.5 Transportation/Public Systems

Public systems include streets, sidewalks, transit, parks and pathways and together represent a prime determinant of neighbourhood character and livability. An underlying premise of the Concept Plan is to create a neighbourhood of streets that are oriented to the pedestrian. Such streets are pleasant and safe and allow people to reach destinations within and outside the community on foot, on bike, on the bus, or in the car. In this respect, tree planting is an integral part of the street environment and shall be part of the area design.

Within the Concept Plan area, the street system is the primary pedestrian pathway system although it is supplemented by pathways through the large park. A number of measures will be undertaken to encourage and support walking, cycling and transit. These include the planting of street trees in the boulevards, wherever possible, direct pedestrian connections, conveniently located bus stops, and overlooking of sidewalks and streets from adjacent shops, houses and offices.

The proposed road network is an extension of the existing grid pattern of streets in the community (Figure 23). Murdock Road will be rebuilt, 8th and 8A Streets will reconnect to 1st Avenue and Murdock Road, and 9th Street will extend from 1st Avenue to form a new connection with Memorial Drive. 7A St will be closed south of Murdock Road so that it can be integrated into the central park. The 8th St access to Memorial Drive will also be closed in favour of the 9th St access. Shifting the road access on Memorial Drive east to 9th St allows a better bus connection to be made to the LRT and provides a direct connection to 1st Avenue. This will benefit businesses on 1st Avenue. The 9th St access also provides a better condition than the current access at 8th St for traffic merging onto Memorial Drive before the 4th Avenue overpass. However, it will be important to incorporate appropriate traffic calming measures along 9th St in order to deter shortcutting north of 1st Avenue.



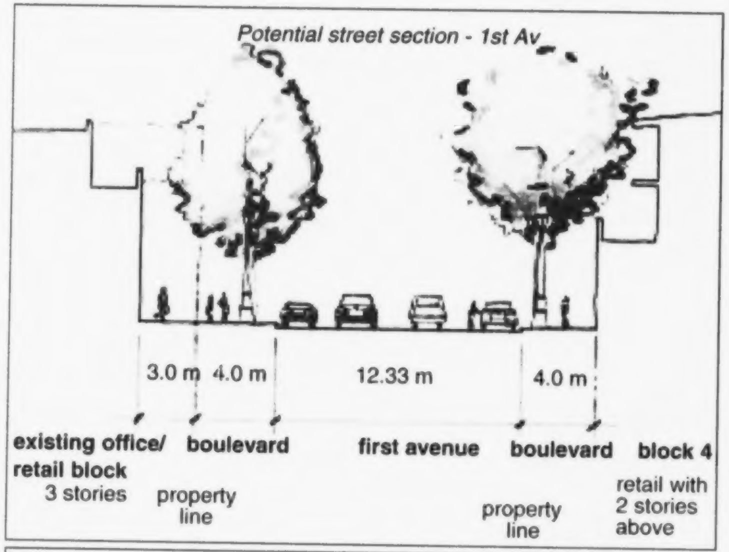
Potential street section for 8/8A St

- **Traffic Calming**

Traffic calming is an important component of the transportation plan. Traffic calming reduces the negative impacts of higher traffic volumes and also reduces incentives for shortcutting through the community. Locations for proposed traffic calming measures are identified in Figure 23. Options for traffic calming will be reviewed and implemented as detailed roadway and engineering is completed.

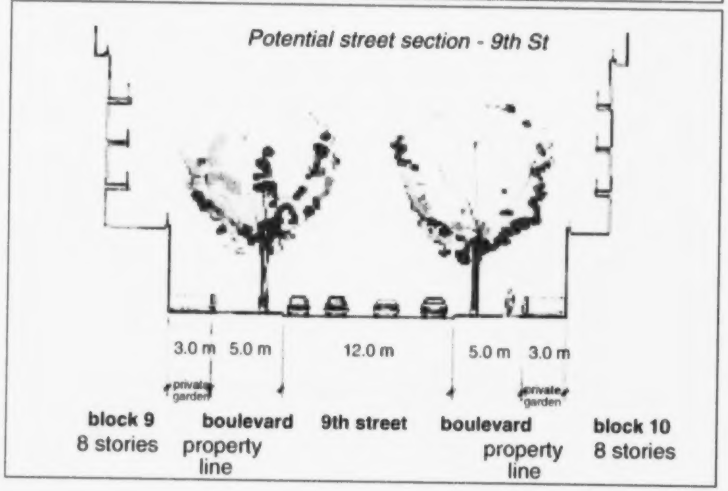
Policies

1. The design and alignment of the street system should discourage short-cutting, reduce vehicle speed and promote a safe pedestrian and cyclist-friendly environment. In general, the area streets should be designed in a manner consistent with the overall character of the Bridgeland-Riverside community instead of adopting



Potential street section - 1st Av

3.0 m
4.0 m
12.33 m
4.0 m
existing office/ retail block
3 stories
boulevard
property line
first avenue
boulevard
property line
block 4
retail with 2 stories above



Potential street section - 9th St

3.0 m
5.0 m
12.0 m
5.0 m
3.0 m
private garden
private garden
block 9
8 stories
boulevard
property line
9th street
boulevard
property line
block 10
8 stories

standards appropriate to new suburban development. Typical cross-sections for Connector, Avenue and High Street as set out in the Alternative Street Design Standards (1999) are preferred to Collector or Primary Collector cross-sections.

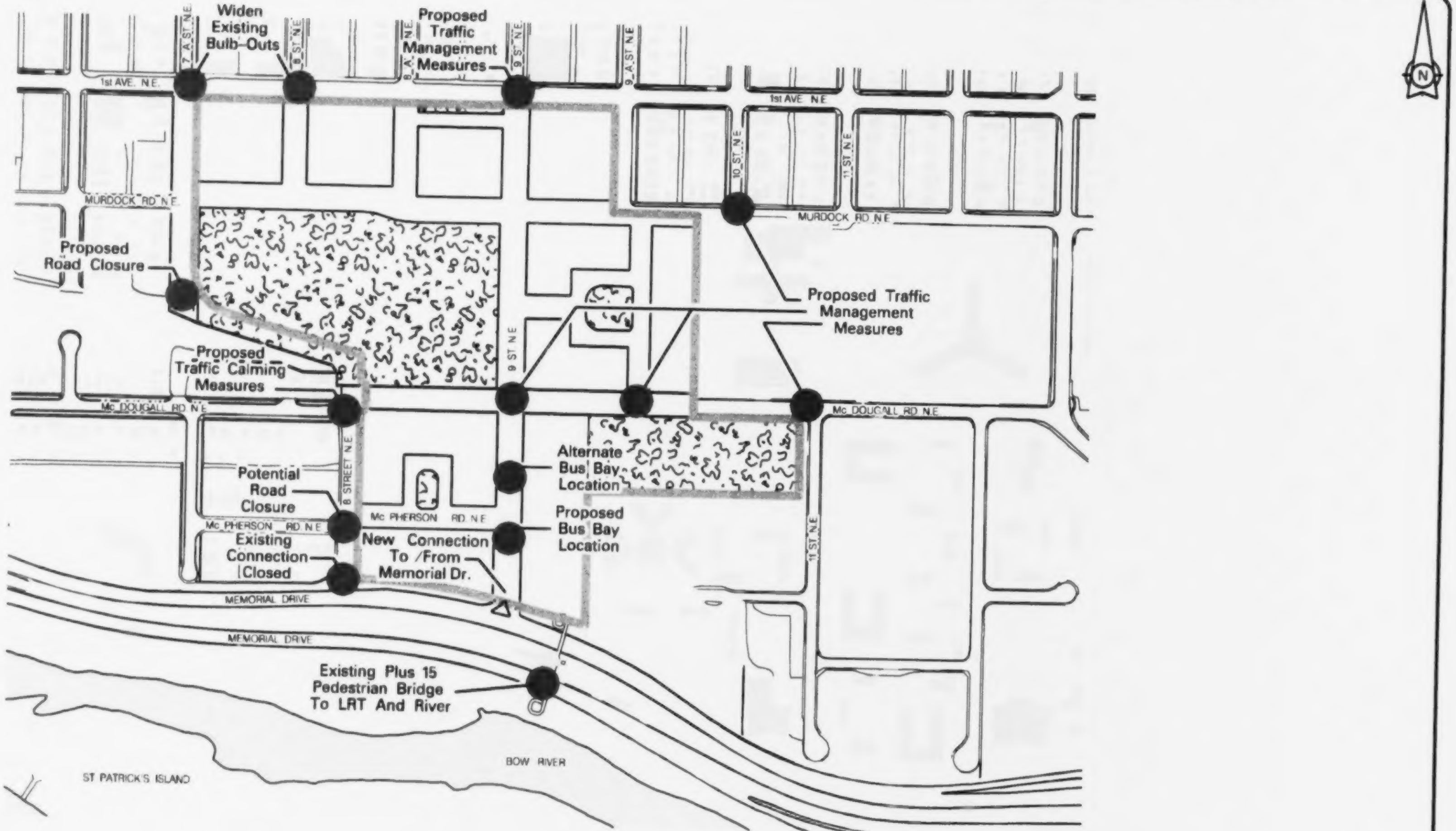
2. Streets should be designed so that street widths, design speed and the number of travel lanes are kept to a minimum, are acceptable to The City, are consistent with the existing community roads, accommodate the anticipated mixed-use traffic and transit, and do not compromise car safety, on-street parking or bicycle access.

3. Traffic calming measures will be installed with the initial construction of new roads (e.g. 9th Street) and/or developments (e.g. sites on 1st Avenue).

4. As shown in Figure 23, the internal road network includes the following features:

   - 9th Street - a north/south road that provides a direct route linking Memorial Drive to 1st Avenue. It is designed to carry traffic in a way that is compatible with pedestrian and cyclist traffic. Measures should be taken to deter the use of 9th Street as a convenient through route for traffic with destinations outside the community.

   - Murdock Road will be rebuilt to provide an east/west connection between 7A Street and 9A Street.


Widen Existing Bulb-Outs
Proposed Traffic Management Measures
7 A ST N.E.
8 ST N.E.
8 A ST N.E.
9 ST N.E.
9 A ST N.E.
1st AVE. N.E.
10 ST N.E.
11 ST N.E.
MURDOCK RD N.E.
Proposed Road Closure
Proposed Traffic Calming Measures
Mc DOUGALL RD N.E.
Proposed Traffic Management Measures
Potential Road Closure
8 STREET N.E.
Mc PHERSON RD N.E.
Existing Connection Closed
New Connection To /From Memorial Dr.
Alternate Bus Bay Location
Proposed Bus Bay Location
MEMORIAL DRIVE
Existing Plus 15 Pedestrian Bridge To LRT And River
ST PATRICK'S ISLAND
BOW RIVER
N

▬ Site Boundary

Bridgeland - Riverside

Figure 23

Proposed Street Network

May 2002

0 50 100 200
metres

THE CITY OF CALGARY
PLANNING & TRANSPORTATION POLICY

\\work\work\plan\plans\arp\bridgeland\proposed_streets.dgn
DATE PLOTTED 02-MAY-2002

- 8th and 8A Streets will be rebuilt between 1st Avenue and Murdock Road providing access to adjacent development and to the community hall.
- 7A Street will be closed between the top of the escarpment and McDougall Road. The right-of-way will be incorporated into the central park.
- 8th Street will be closed between McPherson Road and Memorial Drive NW. Further study will be required to determine whether or not it is advantageous to close the access from McPherson Road west of 8th Street. This should be reviewed in more detail at the land use designation stage.

Traffic calming, pedestrian environment

5. The pedestrian system, public open spaces, private walkways and principal entrance of all buildings should be accessible to the disabled.

6. Internal and external circulation routes should be designed to enhance security. Blind corners and heavy landscaping that obstructs sight lines along pedestrian routes should be avoided.

7. Boulevards will be landscaped with street trees, grass, textured paving surfaces, benches, etc. in order to beautify the public realm and support pedestrian use. In order to optimize the number of street trees, shallow utilities (e.g. gas and electric and communication cables) may not locate under the boulevards but should locate under the sidewalk or in the road right-of-way under the paved driving surface.

8. Wherever possible, utility servicing should coincide with driveway locations so that tree planting will not be reduced in the boulevards. Pre-servicing of lots should only be allowed once driveway locations are accurately known.

9. Curb cuts will be provided at sidewalk crossings to ensure accessibility for the disabled.

9.6 Implementation

The ARP Amendment provides the policy framework that will guide redevelopment within the study area in accordance with the Concept Plan. Implementation of the Concept Plan requires further planning approvals including Outline Plans, Land Use Redesignations, plans of subdivision, development permits and building permit applications. Other implementation actions will include disposition of land, preparation of architectural design guidelines and road closures. A detailed overview of the planning and implementation processes and their legal and administrative framework is found in 'A Community Guide to the Planning Process and Public Participation in the Planning Process'. The following sections briefly outline the major implementation processes for the Concept Plan area.

9.6.1 Outline Plan/Land Use Redesignations

The ARP Amendment and Concept Plan provide the policy basis for subsequent Outline Plans of Subdivision and Land Use Redesignations. Outline plans are prepared as an initial stage in major subdivision applications, to ensure a sound distribution of land uses, open space, road network, etc. Outline plans are approved by the Calgary Planning Commission and form the basis for subdivision of the area into private and public parcels and public rights-of-way. An outline plan for the Concept Plan area will conform with the development concept stated in the ARP amendment and will deal generally with the locations of roads, municipal reserves and utilities.

Land use designations establish the land use and development rules for individual land use components of the Concept Plan and are processed in conjunction with the outline plan application. Land use designations (zoning) are the primary legal control on the potential use of a parcel of land. The rules and regulations of each district are set out in Land Use Bylaw 2P80. The Bridgeland-Riverside ARP, including this Amendment, supplement the Land Use Bylaw by providing a local policy context and specific land use and development guidelines to assist the Development Authority in deciding on land use and development proposals. Land use designations are approved by City Council at a public hearing.

A range of residential, commercial, institutional and other land use designations, including Direct Control (DC) with appropriate development and design guidelines will be established to implement the Plan objectives.

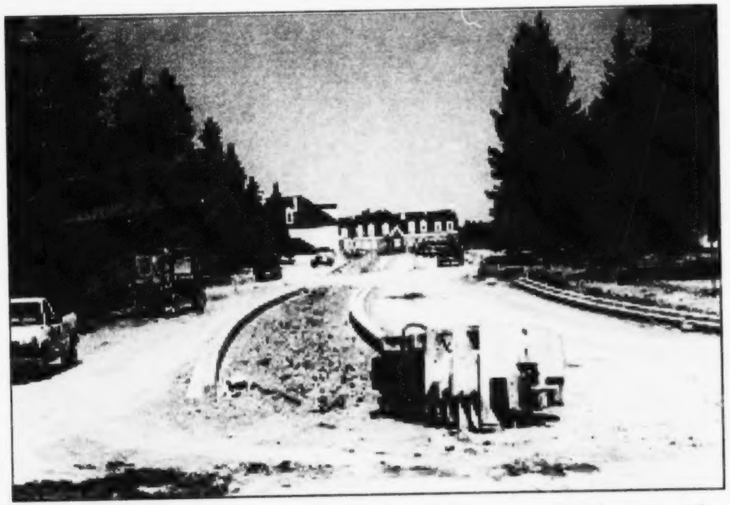
Utility infrastructure

9.6.2 Road Closures

The Concept Plan requires the closure of portions of 7A Street and 8th Street and potentially, McPherson Road. The closure of these road rights-of-way are subject to a Public Hearing of Council. Road closure applications will be submitted by the landowner/developer concurrently with the outline plan and land use designation applications.

9.6.3 Phasing

Following approval of the ARP amendments, road closures, Outline Plan and Land Use Redesignations, development and servicing of the site will proceed.

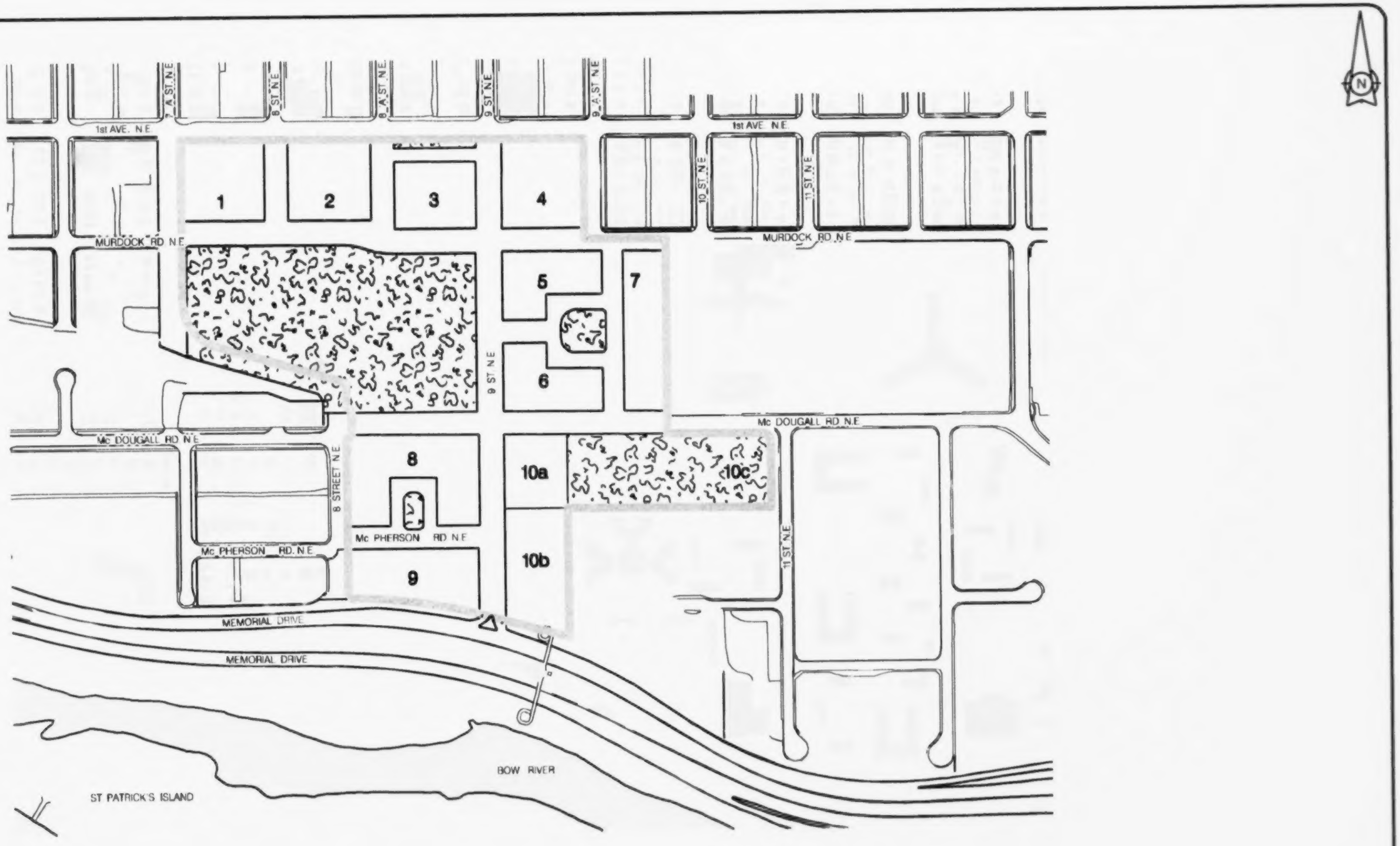


Road construction

Development will be influenced, in part, by the availability of roadways and services, which will be better known following approval of the Outline Plan. In general, it is anticipated that grading and development of the new central park will occur during the first phase to be developed, in conjunction with residential development between the park and 1st Avenue. Once the park has been developed, the new community hall could be built, freeing up portions of the existing Riverside Park for redevelopment. The last phases to be developed will be those parcels impacted by the laundry building, which could remain on site until 2008.

Policies

1. Depending upon the phasing pattern of development in this area, it may be necessary for the Developer to relocate utilities outside their immediate development area. Cost sharing and recovery arrangements will be to the satisfaction of the City Engineer.


1st AVE. N.E.
7_A_ST_N.E.
8_ST_N.E.
8_A_ST_N.E.
9_ST_N.E.
9_A_ST_N.E.
1st AVE. N.E.
10_ST_N.E.
11_ST_N.E.
MURDOCK RD N.E.
MURDOCK RD N.E.
1
2
3
4
5
6
7
9 ST N.E.
Mc DOUGALL RD N.E.
Mc DOUGALL RD N.E.
8 STREET N.E.
8
10a
10c
10b
9
Mc PHERSON RD N.E.
Mc PHERSON RD. N.E.
11 ST N.E.
MEMORIAL DRIVE
MEMORIAL DRIVE
BOW RIVER
ST PATRICK'S ISLAND
N

Site Boundary

Bridgeland – Riverside

Figure 24

Block Plan

May 2002

0 50 100 200
metres

THE CITY OF CALGARY
PLANNING & TRANSPORTATION POLICY

\\work\work\plan\plans\arp\br[illegible]\block_numbers.dgn
DATE PLOTTED 02-MAY-2002

PART 6

SUPPORTING
INFORMATION
2000 AMENDMENT

BOW VALLEY CENTRE CONCEPT PLAN
Supporting Information to 2002 Update
BRIDGELAND-RIVERSIDE AREA REDEVELOPMENT PLAN

TABLE OF CONTENTS

Part 6

Page

1.0 Preface 3
  1.1 Purpose 3
2.0 Bow Valley Centre Study Area 3
  2.1 Study Area Boundaries 3
3.0 Bridgeland-Riverside Community Profile 5
  3.1 History of Development 5
  3.2 Existing Land Use and Land Use Designations 8
  3.3 Community and City-Wide Growth 8
    3.3.1 Population 9
  3.4 Age Distribution, Household Structure & Socio-Economic Profile 9
    3.4.1 Age Distribution 9
    3.4.2 Household Structure 11
    3.4.3 Socio-Economic Profile 12
  3.5 Distribution of Housing Types 12
  3.6 1 Avenue NE Businesses 15
  3.7 Public Parks, Open Space and Community Facilities 16
  3.8 Schools 18

Page

4.0 Bow Valley Centre Study Area Profile 23
  4.1 Study Area Topography and Natural Features 23
  4.2 Ownership of BVC Lands 23
  4.3 Laundry Building 23
  4.4 Environmental 23
  4.5 Existing Transportation System 23
    4.5.1 Roadway Network 23
    4.5.2 Public Transportation 25
    4.5.3 Roadway Characteristics 27
    4.5.4 Parking 27
    4.5.5 Pedestrian Circulation 27
  4.6 Existing Services and Utilities 27
    4.6.1 Surface Topography and Drainage 27
    4.6.2 Servicing and Utilities 29
  4.7 Development Constraints 29
    4.7.1 Bow River Floodway and Floodplain 29
    4.7.2 Calgary International Airport Vicinity Protection Area 29
    4.7.3 Surface Transportation, Noise Attenuation Requirements 31
  4.8 Hospital Commemoration 31

Continued...

BOW VALLEY CENTRE CONCEPT PLAN
Supporting Information to 2002 Update
BRIDGELAND-RIVERSIDE AREA REDEVELOPMENT PLAN

TABLE OF CONTENTS

Part 6

Page

5.0 Policies Affecting the Amendment 31
- 5.1 The Calgary Plan (Municipal Development Plan) 31
- 5.2 Bridgeland-Riverside Area Redevelopment Plan 32
- 5.3 Transit Friendly Design Guide 33
- 5.4 Inner City Transportation Study 33

6.0 Planning and Public Consultation Processes 33
- 6.1 Planning and Public Participation Processes 33
- 6.2 Planning Advisory Committee 35
- 6.3 Key Stakeholders 36

7.0 Context for the Concept Plan 36
- 7.1 General 36

LIST OF FIGURES

1. Study Area Boundaries and Sub Areas 4
2. Bridgeland-Riverside Historical and Forecasted Population Growth 1969 - 2018 9
3. Age Distribution 1989 Comparison 10
4. Age Distribution 1999 Comparison 10
5. Period of Construction of Existing Housing Stock 13
6. Occupied Dwellings by Structure Type 14
7. Open Space and Community Facilities 18
8. Natural Features 22
9. Roadway, Network and Transportation Services 24
10. Proposed Site Grading Following Demolition and Existing Site Topography 26
11. Servicing and Utilities 28
12. Development Constraints 30
13. Bow Valley Centre Redevelopment Project Process 34

LIST OF TABLES

1. Single and Two-Family Residential Building Permits January 01, 1989 to November 01, 1999 6
2. Multi-Residential Building Permits January 01, 1989 to November 01, 1999 7
3. Commercial Building Permits January 01, 1989 to November 01, 1999 7
4. Household Structure, 1996 11
5. Socio-Economic Profile 12
6. Open Space Inventory 17
7. Open Space 20

APPENDICES 39

BACKGROUND AND SUPPORTING INFORMATION

1.0 Preface

1.1 Purpose

This section of the Bridgeland-Riverside Area Redevelopment Plan (ARP) provides the background and supporting information to the amendment that addresses redevelopment for the former Bow Valley Centre (BVC). The purpose of this information is to describe the context within which the planning objectives and policies of the amendment were developed.

This section is not part of the approved ARP amendment and therefore has no legal status.

2.0 Bow Valley Centre Study Area

2.1 Study Area Boundaries

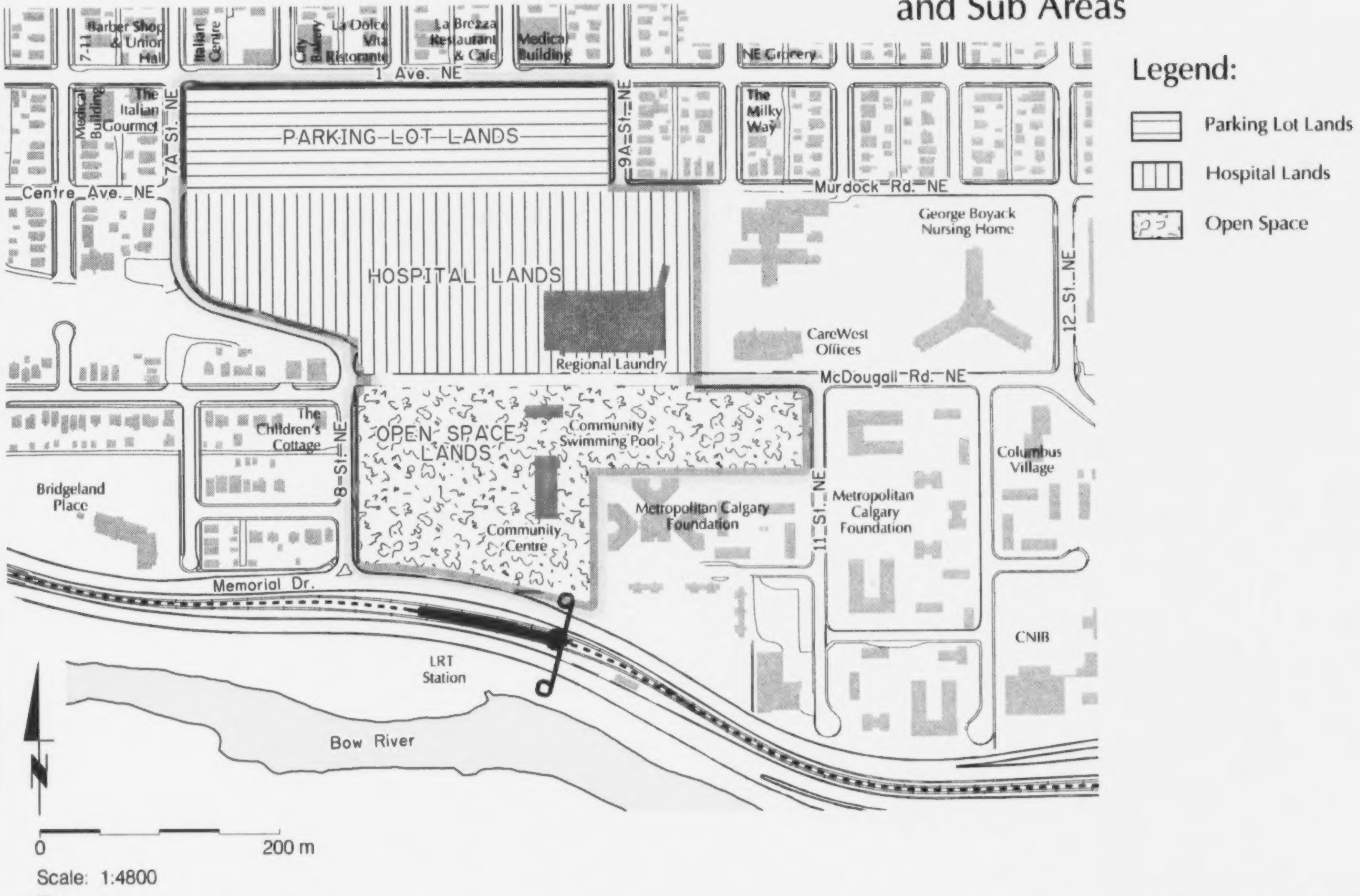
The BVC study area (former Bow Valley Centre) is part of the Bridgeland-Riverside community, an older inner-city community located in the northeast sector and in very close proximity to Downtown Calgary. It is located centrally within the community of Bridgeland-Riverside and straddles the upper (Bridgeland) and lower (Riverside) portions of the community. The study area, as illustrated in Figure 1, is bounded by 1 Avenue NE to the north, Memorial Drive to the south, 7A Street NE and 8 Street NE to the west and 9A Street NE to Centre Avenue (Murdock Road), 10 Street NE (Cross Bow Auxiliary Hospital) to McDougall Road NE, 11 Street NE and the Metropolitan Calgary Foundation lands to the east.

The study area comprises three distinct sites or sub-areas. The northern site, extending from Murdock Road north to 1 Avenue NE, contains the former hospital's *Parking Lot Lands*. The central site, extending from McDougall Road on the south to Murdock Road on the north, encompasses the *Hospital Lands*. All of the former BVC hospital buildings were located within this area. The third site, extending south from McDougall Road to Memorial Drive and the Metropolitan Calgary Foundation lands, encompasses the *Open Space Lands*. These lands were included in the study area because of their proximity to the Bridgeland Light Rail Transit (LRT) Station and the potential for heightened transit supportive redevelopment.

The approximate areas of each of the three sub-areas and the total study area are as follows:

Sub-Area	Hectares	Acres
Parking Lot Lands	3.21	7.94
Hospital Lands	5.64	13.94
Open Space Lands	4.18	10.32
McDougall Rd	0.30	0.75
TOTAL STUDY AREA	**13.33**	**32.95**

Figure 1 Study Area Boundaries and Sub Areas


Legend:
▤ Parking Lot Lands
▥ Hospital Lands
Open Space
PARKING-LOT-LANDS
HOSPITAL LANDS
OPEN SPACE LANDS
Barber Shop & Union Hall
7-11
Italian Centre
City Bakery
La Dolce Vita Ristorante
La Brezza Restaurant & Cafe
Medical Building
NE Grocery
1 Ave. NE
Medical Building
The Italian Gourmet
7A St. NE
9A St. NE
The Milky Way
Centre Ave. NE
Murdock Rd. NE
George Boyack Nursing Home
CareWest Offices
12 St. NE
Regional Laundry
McDougall Rd. NE
The Children's Cottage
8 St. NE
Community Swimming Pool
Columbus Village
Bridgeland Place
Metropolitan Calgary Foundation
11 St. NE
Metropolitan Calgary Foundation
Community Centre
Memorial Dr.
CNIB
LRT Station
Bow River
0
200 m
Scale: 1:4800

THE CITY OF CALGARY
PLANNING & BUILDING DEPARTMENT

3.0 Bridgeland-Riverside Community Profile

3.1 History of Development

Development of the Bridgeland-Riverside area dates from around the turn of the century, when the Langevin Bridge was built across the Bow River. The fledgling Bridgeland community was annexed to The City in 1907, with Riverside joining in 1910. Another major event of that year was the opening of the Calgary General Hospital on the Bow Valley Centre site.

From its earliest days, this community became home to a large number of immigrant working class families. Riverside was predominantly German, while the Bridgeland community had a distinctive Italian heritage, which can be seen to this day in the restaurants and shops along 1 Avenue NE.

Bridgeland-Riverside grew steadily, more or less, throughout the first half of this century, but growth has declined noticeably since about 1960. With young families moving out to the newer suburbs, the population of the area has aged considerably. Organizations such as the Knights of Columbus, CareWest (now a wholly-owned subsidiary of the CRHA), and the Metropolitan Calgary Foundation have developed extensive housing and special care facilities for seniors in close proximity to the former Calgary General Hospital (Bow Valley Centre) and its neighboring Cross Bow Auxiliary Hospital.

Currently, the Metropolitan Calgary Foundation has indicated that it is in the process of intensifying the development of its lands immediately east of the BVC site. Over the next 30 years, the Foundation has announced plans to construct new seniors' facilities with over 1100 units. The overall site is located along the north side of Memorial Drive NE between 11A Street NE and the Bridgeland-Riverside Community Association's buildings and covers approximately 8.03 hectares (19.85 acres). The first phase of redevelopment, 133 units, has been completed and a development permit for 0.97 hectares (2.39 acres) has been approved for an additional 267 units.

The Cross Bow Auxiliary Hospital is being phased out of operation, but future plans for the site are currently uncertain.

The Children's Cottage, a multi-residential care facility, the Calgary Women's Emergency Shelter and the Calgary Catholic Immigration Society (a hostel for sponsored refugees) are also located in the Bridgeland-Riverside community.

During the period of January 01, 1989 to November 01, 1999 there were 32 new single-family and two-family residential building permits (Table 1) and 9 new multi-family (3 units or more) building permits issued (Table 2). The total value of residential building permits, including both new construction and renovations, was estimated to be $13,445,584. Table 3 indicates the number of commercial building permit applications.

Table 1 - Single and Two-Family Residential Building Permits January 01, 1989 - November 01, 1999

Year	SINGLE RESIDENTIAL						
	New				Addition/Improvement/ Repairs		Demo
	# of Residential Permits	# of Garage Permits	# of Units	Estimated Value	# of Permits	Estimated Value	#
1989	-	9	-	$82,811	18	$113,043	-
1990	-	8	-	$63,141	10	$190,500	5
1991	-	4	-	$37,836	12	$137,716	-
1992	1	6	1	$156,807	11	$287,243	3
1993	8	2	8	$790,426	12	$231,802	7
1994	5	4	5	$562,854	11	$182,815	5
1995	2	5	2	$255,791	9	$230,106	9
1996	1*	2	2	$118,316	7	$143,188	2
1997	7(2*)	6	9	$1,109,540	4	$102,848	4
1998	6(2*)	5	8	$1,025,282	13	$175,260	5
1999	2	7	2	$390,358	9	$106,760	3
Total	**32**	**58**	**37**	**$4,593,162**	**116**	**$1,901,281**	**43**

** number of permits issued for two-family dwellings*

Source: City of Calgary, Planning & Building Department

Table 2 - Multi-Residential Building Permits
January 01, 1989 - November 01, 1999

Year	MULTI-RESIDENTIAL TOWNHOUSE/APARTMENT					
	New			Addition/ Improvement/ Repairs		Demo
	# of Permits	# of Units	Estimated Value	# of Permits	Estimated Value	#
1989	-	-	-	-	-	-
1990	-	-	-	-	-	-
1991	2	17	$573,000	-	-	1
1992	-	-	-	1	$6,500	1
1993	1	3	$150,000	-	-	-
1994	1	6	$290,000	1	$57,779	-
1995	1	16	$870,000	-	-	-
1996	1	4	$300,000	-	-	-
1997	1	24	$965,000	3	$970,000	-
1998	1	33	$2,300,000	-	-	-
1999	1	5	$468,862	-	-	-
Total	**9**	**108**	**$5,916,862**	**5**	**$1,034,279**	**2**

Source: City of Calgary, Planning & Building Department

Table 3 - Commercial Building Permits
January 01, 1989 - November 01, 1999

Year	COMMERCIAL				
	New		Addition/ Improvement/ Repairs		Demo
	# of Permits	Estimated Value	# of Permits	Estimated Value	#
1989	-	-	2	$96,000	-
1990	1	$725,000	1	$8,000	-
1991	6	$404,000	-	-	1
1992	-	-	6	$288,500	-
1993	-	-	-	-	-
1994	2	$361,860	6*	$371,160	2
1995	1	$3,573,330	-	-	1
1996	-	-	1	$10,000	1
1997	1	$1,259,000	5	$213,300	-
1998	-	-	3	$91,000	-
1999	-	-	2	$15,900	-
Total	**11**	**$6,323,190**	**26**	**$1,093,860**	**5**

** includes City Bakery*

Source: City of Calgary, Planning & Building Department

3.2 Existing Land Use and Land Use Designations

The current general land use plan for Bridgeland-Riverside is depicted in Part 2 on page 11. Please refer to Part 3, pages 54 to 74 for a more comprehensive description of the existing land uses. Residential areas are identified under three categories: low, medium and high density. The *low-density* area (R-2), located generally north of 1 Avenue NE and east of 6 Street NE, is predominantly single and two-family housing. The *medium density* area to the southeast of the BVC site (RM-5) is characterized by institutional seniors' housing as described above, while the areas to the southwest and west (RM-3 and RM-4) are predominately three-storey walk-up apartment buildings. The *high-density* residential site adjacent to Memorial Drive (DC) is the Bridgeland Place high-rise apartment building (Photo 1). Owned and managed by CalHome Properties, this facility provides subsidized housing for low-income singles and families.

Photo 1 - Bridgeland Place - looking south

There are two commercial areas in the community. Along 1 Avenue NE from 7 Street NE to 9A Street NE is a *local commercial* (C-1) strip of restaurants, shops, and medical office buildings which is discussed in detail under Section 3.6. A general commercial area (C-3), mainly automobile-oriented, is located toward the west side of the community within the Edmonton Trail/4 Avenue NE one-way couplet.

The remainder of the community is characterized by institutional (PS) uses including the former BVC site, CareWest and CNIB facilities; open space (PE) including the community playgrounds and facilities to the south of the BVC site, a number of school sites, and the Calgary Zoo and expansion area (A and UR).

3.3 Community and City-Wide Growth

Beginning in the 1950s, Calgary entered into a long-term pattern of growth that has seen its population rise from less than 200,000 to 842,388 in 1999. With a 1999 population increase of 23,054 and net migration of over 15,629 Calgary has entered into a new era of accelerated growth. The amount and rate of growth creates a context in which development must be accommodated. Increased population can ensure the viability of new and existing businesses, schools and recreation facilities. Rejuvenation brought about by growth enables revitalization of existing housing stock. This development brings potential benefits but also challenges for inner city communities.

Redevelopment or community intensification needs to be sensitive to the community's physical environment so as to enhance or retain the character of the community.

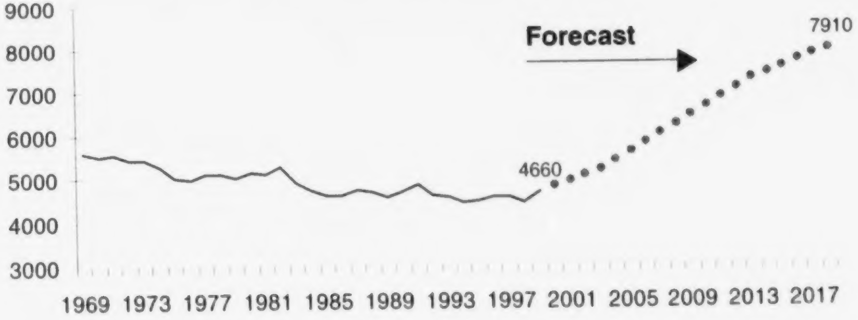
3.3.1 Population

The historical population trend and future forecast for Bridgeland-Riverside is shown graphically in Figure 2.

The current population of Bridgeland-Riverside is 4,660 (1999 Civic Census). Between 1969 - 1999, the population has declined by 17% or 937 people. This decline in population is characteristic of inner city communities and relates to an overall decline in household size as well as the effects of the lifecycle - children grow up and leave the community to establish their own households, families have fewer children, seniors live alone in their homes longer, and more singles live alone today than in the past.

Figure 2

Bridgeland-Riverside Historical & Forecasted Population Growth 1969 - 2018



(Source: City of Calgary Civic Census (1987, 1997, and 1999)

Redevelopment of the BVC and Metropolitan Calgary Foundation sites represents an opportunity to reinvigorate the Bridgeland-Riverside community. As well, redevelopment activity throughout the rest of the community will add to the overall population. In total, the population is projected to increase by 3,250 people over the next 18 years. This is a significant increase in population; however, to some extent it is merely a replacement for the activity generated by the hospital which employed 3,000 people and contained 1,000 beds.

3.4 Age Distribution, Household Structure & Socio-Economic Profile

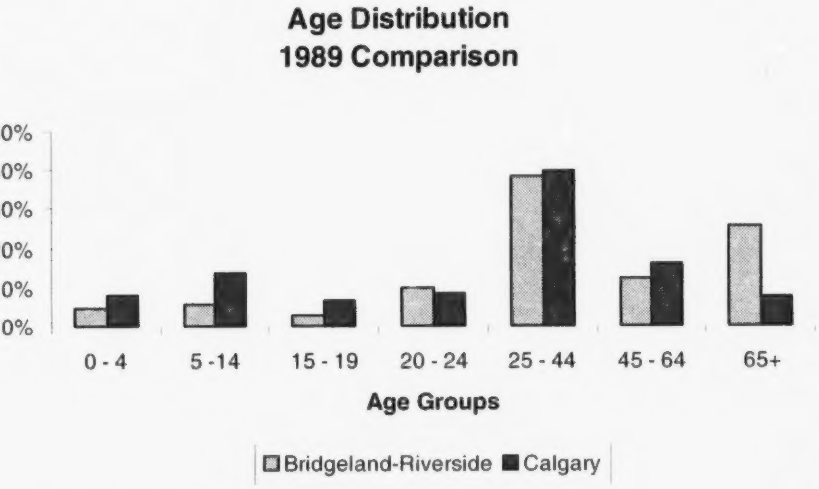
3.4.1 Age Distribution

The age profiles presented in Figures 3 and 4 compare Bridgeland-Riverside with the overall city and indicate the changes that have occurred between 1989 and 1999. There is very little difference in the age distribution between 1989 and 1999 for the community and the overall city. The most significant differences in the 1999 data are:

	Bridgeland- Average	**City-Wide**	**Riverside**
Children	5-19	8.3%	20.2%
Seniors	75+	15.7%	3.5%

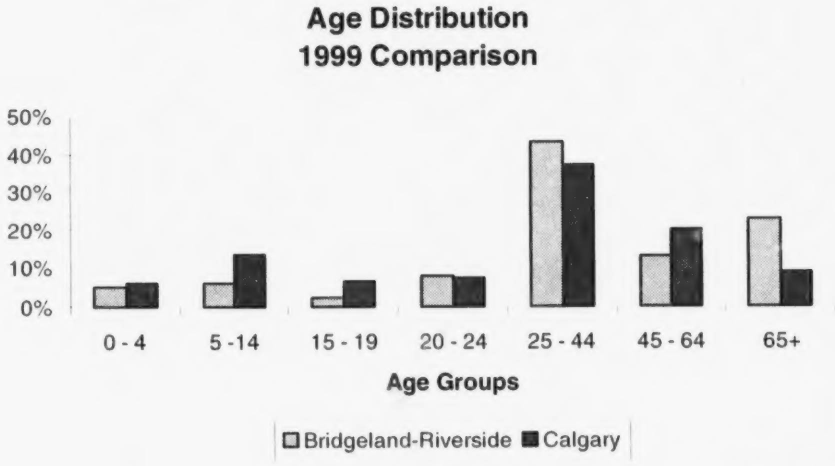
(Source. City of Calgary Civic Census 1999)

Figure 3



Source: City of Calgary Civic Census (1989)

Figure 4



Source: City of Calgary Civic Census (1999)

3.4.2 Household Structure

Statistics Canada 1996 census information indicates that 44 percent of the Bridgeland-Riverside households are comprised of families[1] as compared to 71 percent for the overall city. The high percentage of individuals living alone (47%) is characteristic of older inner city communities and the concentration of seniors' housing in this community is a significant factor.

Table 4 Household Structure, 1996

	Bridgeland-Riverside		**City-Wide**	
	Number	**%**	**Number**	**%**
Living Alone	1020	47.0	68605	23.8
Families:				
Spouses/ Common-law partners				
With Children	245	11.3	104455	36.2
Without Children	485	22.4	71825	24.9
Lone Parent	220	10.1	27950	9.7
Other	200	9.2	15490	5.4
Total Households	**2170**	**100**	**288325**	**100**

Source: Statistics Canada 1996 Census

---

[1] Statistics Canada defines the term 'family persons' as:

"household members who belong to a census family. They in turn, are further classified as follows:

> Spouses refer to persons of opposite sex who are legally married to each other and living in the same dwelling.
>
> Common-law partners are two persons of opposite sex who are not legally married to each other but live together as husband and wife in the same dwelling.
>
> Lone Parent refers to a mother or father, with no spouse or common-law partner present, living in a dwelling with one or more never-married sons and/or daughters.
>
> Never-married sons and/or daughters refers to blood, step or adopted sons and daughters who have never married (regardless of age) and are living in the same dwelling as their parent(s)."

(Statistics Canada 1996 Census Dictionary, pg 121)

3.4.3 Socio-Economic Profile

In addition to having a high proportion of seniors relative to the average Calgary community, Bridgeland-Riverside also has relatively higher proportions of what are considered to be "population at risk". This assessment is based on the indices shown in Table 5.

Table 5 Socio-Economic Profile

	Bridgeland-Riverside	City-wide Average
Recipients of Assured Income for Persons with Severe Handicaps[1]	3.5%	1.1%
Recipients of Support for Independence[1]	3.5%	1.7%
Seniors receiving Guaranteed Income Supplement[2]	55.2%	30.9%
Persons lacking secondary school certification[2]	33.0%	27.0%
Persons with a university degree3	17.0%	19.0%
Unemployment rate[3]	8.9%	6.7%
Median household income[3]	$24,689	$45,777
Users of Special Needs Taxi transportation[4]	3.6%	1.0%

Bridgeland-Riverside has traditionally been the home of lower income working families. The median household income in Bridgeland was $24,689.00 in 1996 compared to $45,777.00 for Calgary. Fifty-seven percent of the households in Bridgeland-Riverside had a household income of less than $30,000.00 while in Calgary only 31% had a similar income. The lower median household income is in part a reflection of the relatively high concentration of low income senior citizens in the community.

3.5 Distribution of Housing Types

As indicated in Figure 5, the majority of housing units presently standing in Bridgeland-Riverside were built prior to 1960 (51%), with approximately 30 percent having been constructed before 1946. (Photo 2) Most of the newer residential development has been in the senior

Photo 2 - Existing housing, west of BVC parking lot lands.

---

[1] Province of Alberta, Family Social Services, 1999 (As of December 31, 1998)

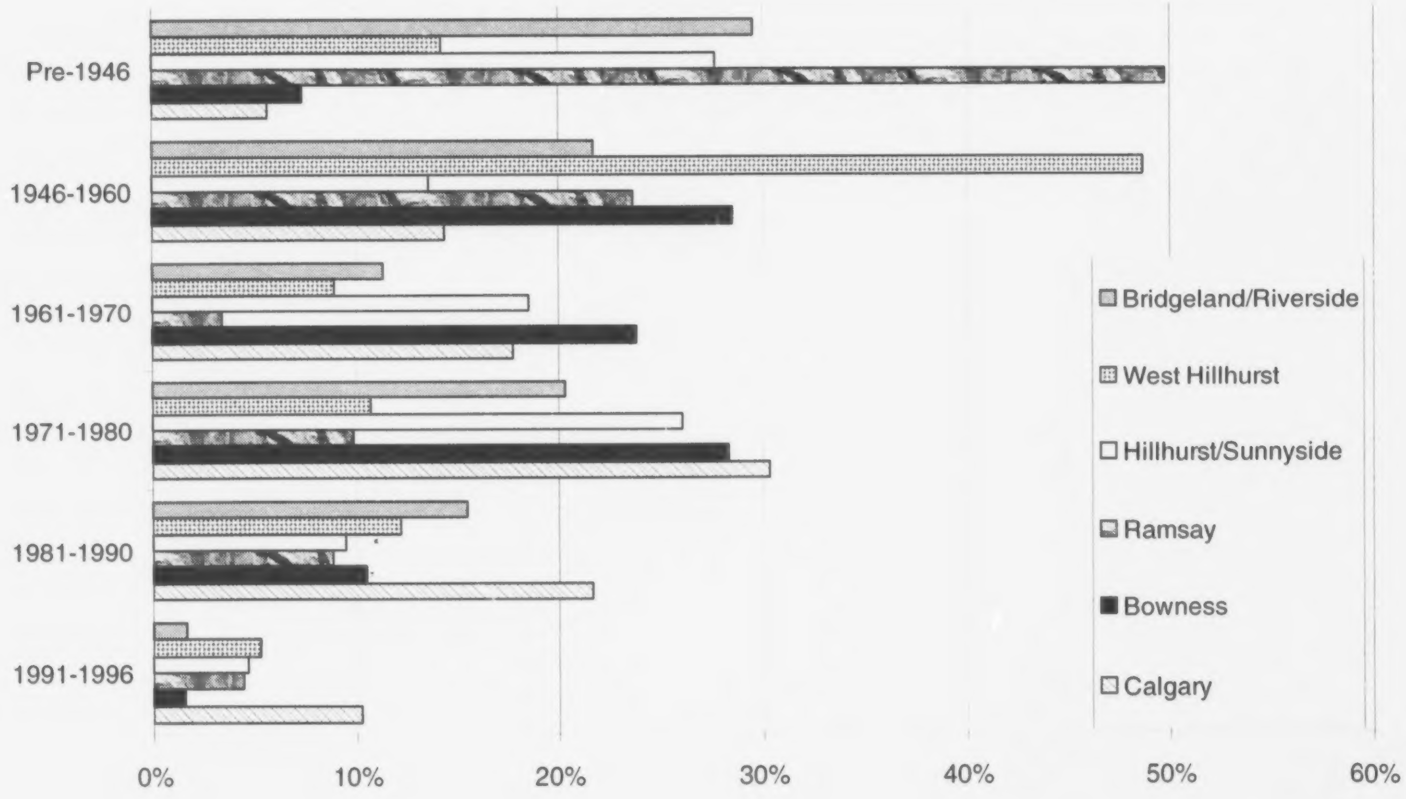
[2] Government of Canada, Human Resources Development Canada, March 1999.

[3] Government of Canada, Federal Census, 1996

[4] City of Calgary, Special Needs Taxi Unit, 1997.

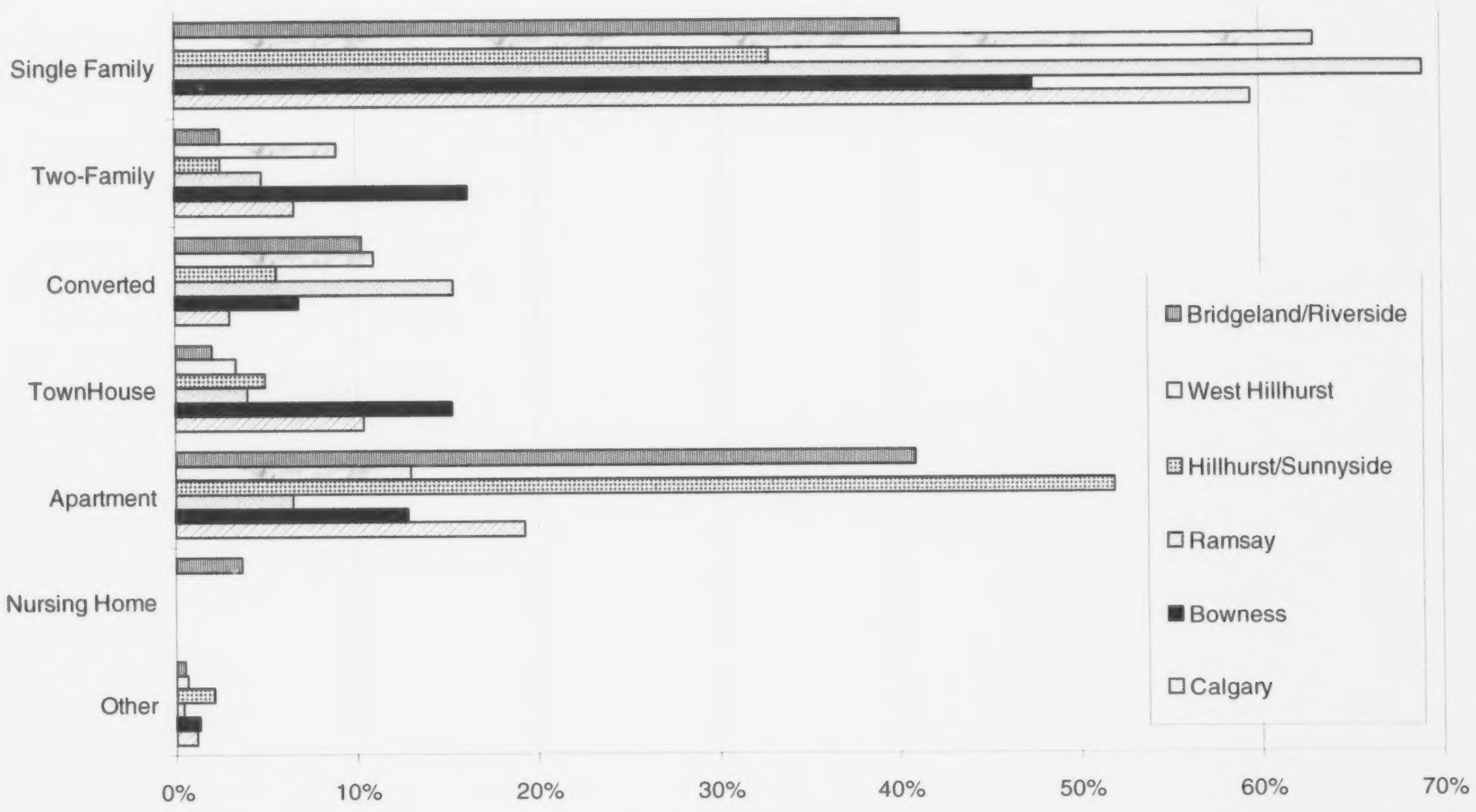
Figure 5

Period of Construction of Existing Housing Stock



Source: Statistics Canada (1996)

Figure 6



Occupied Dwellings by Structure Type

Source: City of Calgary Civic Census (1999) citizens' housing complexes in the southeastern corner of the community or in apartment buildings and infill redevelopment elsewhere. The vacancy rate in April 1999 stood at 3.92 percent, which is slightly higher than the city average (2.34%).

Figure 6 provides the mix of occupied dwelling units by type for Bridgeland-Riverside and several other inner city communities. In Bridgeland-Riverside more than 40% of the occupied dwellings are apartments, which is roughly double the city average (19.3%). In comparison, Bridgeland-Riverside's proportion of apartments exceeds that of Bowness, but is lower than Hillhurst/Sunnyside. Similarly, less than 41% of all occupied dwellings in both Bridgeland-Riverside and Hillhurst/Sunnyside are single-family homes, which is significantly lower than the city average (59.5%). This housing mix would appear to reflect the population profile of Bridgeland-Riverside and its inner city location. As shown by the high proportion of both seniors (22.5%) and recipients of assured income for persons with severe handicaps (3.5%), a significant amount of the housing stock in Bridgeland-Riverside is occupied by those with special needs.

Two other housing statistics are of interest. The average occupancy rate in this community (2.04 persons per unit), which is typical of inner city communities, is substantially lower than the city average (2.65 persons per unit). The difference is especially pronounced with respect to single-family dwellings. Furthermore, only about one-third (35.8%) of Bridgeland-Riverside dwellings are owned by their residents, as compared with almost two-thirds (67.2%) city-wide.

3.6 1 Avenue NE Businesses

In 1992, the 1 Avenue NE Business Association in conjunction with The City of Calgary Planning & Building Department retained the firm of Walker Brown Urban Consultants Ltd. to undertake a Retail Market Study for the 1 Avenue NE business district.

The 1 Avenue business district is located primarily along 1 Avenue between 7 Street NE and 9A Street NE. According to the 1992 survey, the district contained 14 retail stores and services occupying an estimated 17,900 square feet of retail floor space. A pair of three-storey medical buildings provided the majority of the district's 46,000 square feet of office floor space. The 1 Avenue NE business district is quite distinct in character and trade area from the Edmonton Trail/4 Street NE commercial area, which mainly provides automobile service and furniture businesses.

Existing retail floor space along 1 Avenue NE was highly concentrated in the area of specialty food/groceries (40%) and Italian restaurants (25%). Drugstores (16%), convenience stores (9%) and personal services (6%) accounted for most of the remaining floor space. A florist shop was the only existing store in the durable and semi-durable goods category (3%).

At the time of the survey (1992) the trade area consisted of three distinct segments:

1) Bridgeland-Riverside community residents (20-25%);
2) Staff, patients and visitors of the Bow Valley Centre and local medical offices (30-35%); and,
3) Residents of the remaining city-wide trade area (40-45%).

The trade area varies widely for different types of businesses. Specialty food stores, for example, were drawing only 26 percent of their customers from Bridgeland-Riverside or adjacent neighbourhoods and 64 percent from throughout the city and beyond. Approximately 10 percent of these specialty food customers were linking their shopping with a visit to the hospital. Most drugstore customers were patients visiting the medical offices on 1 Avenue, with 15 percent coming directly from the hospital. The customers of grocery/convenience stores and personal services tended to be more locally based (35%), with 20-30 percent linked to the hospital and 35-45 percent from outside the area.

The foregoing market statistics are unlikely to have changed significantly up to the time of the BVC closure (April 01, 1997). However, because the development and marketing strategies recommended in the Walker Brown report assumed the continued existence and future expansion for the Bow Valley Centre, they are no longer valid. It must be assumed that the BVC closure has had a significant impact on many, if not all, of the 1 Avenue NE businesses. Current vacant office space at the two medical office buildings is one obvious area of impact.

The 1 Avenue NE business district is central to the Bridgeland-Riverside community, both geographically and with respect to community identity and cohesion. Its continued and enhanced viability is thus a matter of paramount importance to the community. Prior to 1982, commercial, retail, office, and residential development had existed on the south side of 1 Avenue *(Parking Lot Lands)*. These lands were expropriated in 1982 to accommodate hospital expansion. The feasibility of expanding the commercial district through redevelopment on the south side of 1 Avenue is a key objective of redevelopment.

3.7 Public Parks, Open Space and Community Facilities

Urban parks offer an expression of community and civic pride and enhance community design through landscaping and beautification. They also enhance the quality of life for residents by providing a variety of recreational opportunities within the community. The inclusion of the existing park space and community hall site adjacent to the LRT Station into the BVC redevelopment plan provided an opportunity to re-examine the distribution of park space within the community. The open space and community facilities within Bridgeland-Riverside prior to the redevelopment of the BVC are depicted in Table 6 and Figure 7.

Table 6

Open Space Inventory

Community Recreation Facilites and Parks

Figure 7 Site #	Name	Address	Total Open Space (ha.)	Recreational Open Space (ha.)
1	Community Association bldg. and grounds - including outdoor pool, major soccer field (1), baseball diamonds (3), skating rink, Riverside Park	919 McDougall Rd. NE	4.18	4.18
2	Neighbourhood Park	848 McPherson Rd. NE	.14	.14
3	Community Park	64 - 12 Street NE	.28	.28
4	Neighbourhood Park	520 - 4A Street NE	.25	.25
5	Neighbourhood Park	424 - 9A Street NE	.27	.27
6	Undeveloped open space	1212 Jamieson Avenue	1.73	.00
7	Undeveloped open space	49 - 7 Street NE	1.18	.00
8	Undeveloped open space	536 Edmonton Trail NE	.49	.00
Subtotal			**8.62**	**5.12**

Separate Schools

Figure 7 Site #	Name	Address	Total Open Space (ha.)	Recreational Open Space (ha.)
9	St. Angela's Elementary	231 - 6 Street NE	0.63	0.50
Subtotal			**0.63**	**0.50**

Public Schools

Figure 7 Site #	Name	Address	Total Open Space (ha.)	Recreational Open Sapce (ha.)
10	Bridgeland Elementary	414 - 11A Street NE	1.38	1.09
11	Langevin Elementary and Jr. High	711 - 1 Avenue NE	0.58	.07
12	The "Riverside Bungalow"	711 - 2 Avenue NE	1.00	.83
Subotal			**2.96**	**1.99**

Total Hectares Open Space	**12.61**	
Total Hectares Recreational Open space		**7.61**

Population: Bridgeland-Riverside Community District (1999 Civic Census) **4660**

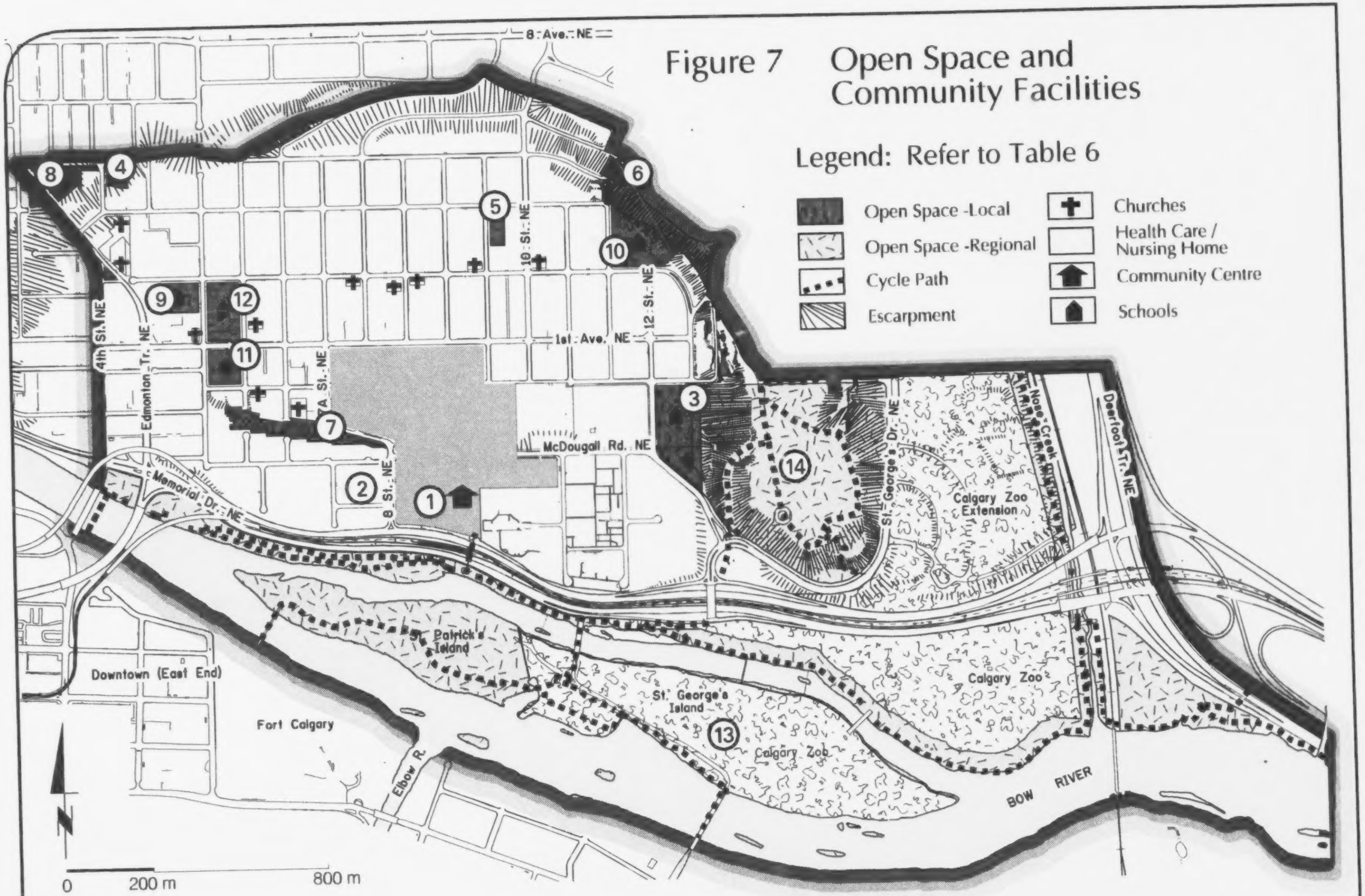
Recreational Open Space Ratio: **1.63 ha/1000 people**

The standard for a Prototype "A" community is 0.9 - 1.3 ha. recreational open space/1000 people *(Inner City Open Space Study)*: currently Bridgeland-Riverside meets that standard.

Regional Recreational Facilities and Parks (Regional amenities which are not included as community open space)

Figure 7 Site #	Name	Address	Total Open Space (ha.)	Recreational Open Space (ha.)
13	Calgary Zoo		53.60	53.60
14	Tom Campbell's Hill		16.73	16.73
Total			**70.33**	**70.33**

Figure 7 Open Space and Community Facilities


Legend: Refer to Table 6
▨ Open Space -Local
▨ Open Space -Regional
Cycle Path
▨ Escarpment
✝ Churches
☐ Health Care / Nursing Home
Community Centre
Schools
8 Ave. NE
4th St. NE
Edmonton Tr. NE
Memorial Dr. NE
1st Ave. NE
7A St. NE
8 St. NE
10 St. NE
12 St. NE
McDougall Rd. NE
St. George's Dr. NE
Nose Creek
Deerfoot Tr. NE
Calgary Zoo Extension
Calgary Zoo
St. Patrick's Island
St. George's Island
Downtown (East End)
Fort Calgary
Elbow R.
BOW RIVER
1
2
3
4
5
6
7
8
9
10
11
12
13
14
0
200 m
800 m
Scale: 1:12000

THE CITY OF CALGARY
PLANNING & BUILDING DEPARTMENT

BOW VALLEY CENTRE
REDEVELOPMENT CONCEPT PLAN

In assessing how the park space within the study area could best benefit the community, a number of factors were taken into account:

- Local and city-wide outdoor recreational and educational needs
- Protection of environmentally significant areas
- Representation of a diversity of natural and man-made features
- Provision of linkages to create a continuous park and pathway system
- Availability of public financial resources.

The primary local open space feature is the community centre site and adjacent parks and playgrounds to the south of the BVC site (4.18 hectares / 10.32 acres). This area contains the Bridgeland-Riverside community building, an outdoor swimming pool, a small seniors' park, several playing fields, and a number of pathways providing access between the BVC site and the Bridgeland LRT Station. (Photo 3). The pool, playfields, and outdoor rink also serve regional users.

Other local open space features within Bridgeland-Riverside include two tot lots, two decorative parks, and several school sites. Within the study area there are no environmentally significant areas; however, the site is adjacent to a secondary escarpment identified as environmentally significant and dedicated as environmental reserve.

Currently, Riverside Park caters primarily to city-wide users (softball leagues) whereas the seniors' park on McDougall Road has a local focus. The community hall accommodates both local and city-wide users. A major source of revenue for the community association has been hall rentals to city-wide groups and revenues from the pub.

Relocating the community hall and the development of a large park at the centre of the community is a corner stone of the BVC redevelopment. Redevelopment will involve relocation of the Riverside Park and freeing up land adjacent to the LRT Station for transit-supportive development. A plaza will be added on 1 Avenue NE between 8 and 8A Streets NE to provide a public gathering point supportive of retail/commercial development.

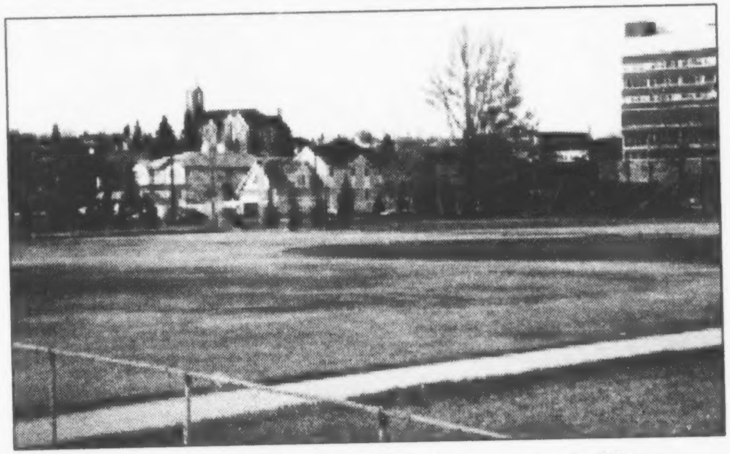


Photo 3 - Park west of Bridgeland-Riverside Community building

The concept plan incorporates a diversity of natural and man-made features and provides linkages to the existing pathway system. Development of the new park space and public system will be financed through the redevelopment of the site as a cost of development. Alternative financial resources would be required for any further enhancements to the parks that may be desired by community residents.

Table 7 outlines the breakdown of open space provision before and after redevelopment:

Table 7 Open Space

	Before BVC Redevelopment	After BVC Redevelopment
Municipal Reserve	1.15 ha (2.85 ac)	TBA
Non-municipal Reserve PE lands	3.03 ha (7.47 ac)	TBA
Total Open Space lands	4.18 ha (10.32 ac)	4.65 ha (11.50 ac)

In summary, redevelopment and relocation of existing parks will be conducted such that redevelopment of the BVC site will increase the total amount of open space within the study area and the community.

The Inner City Open Space Study (ICOSS) establishes the policy standard for assessing the appropriate amount of open space required to meet community local recreational and open space needs in inner city communities. According to the ICOSS, Bridgeland-Riverside is a Proptotype B community where less than 10% of the population is less than 15 years old. The amount of open space that is adequate to meet the needs of a Prototype B community is 0.7 - 0.9 ha/1000. Assuming an ultimate population of 7900, the post-development ratio will be 0.97 ha/1000 which meets the policy standard. Therefore, even though the population is increasing significantly, the community will continue to enjoy an adequate amount of park space.

3.8 Schools

The schools in the community are as identified below:

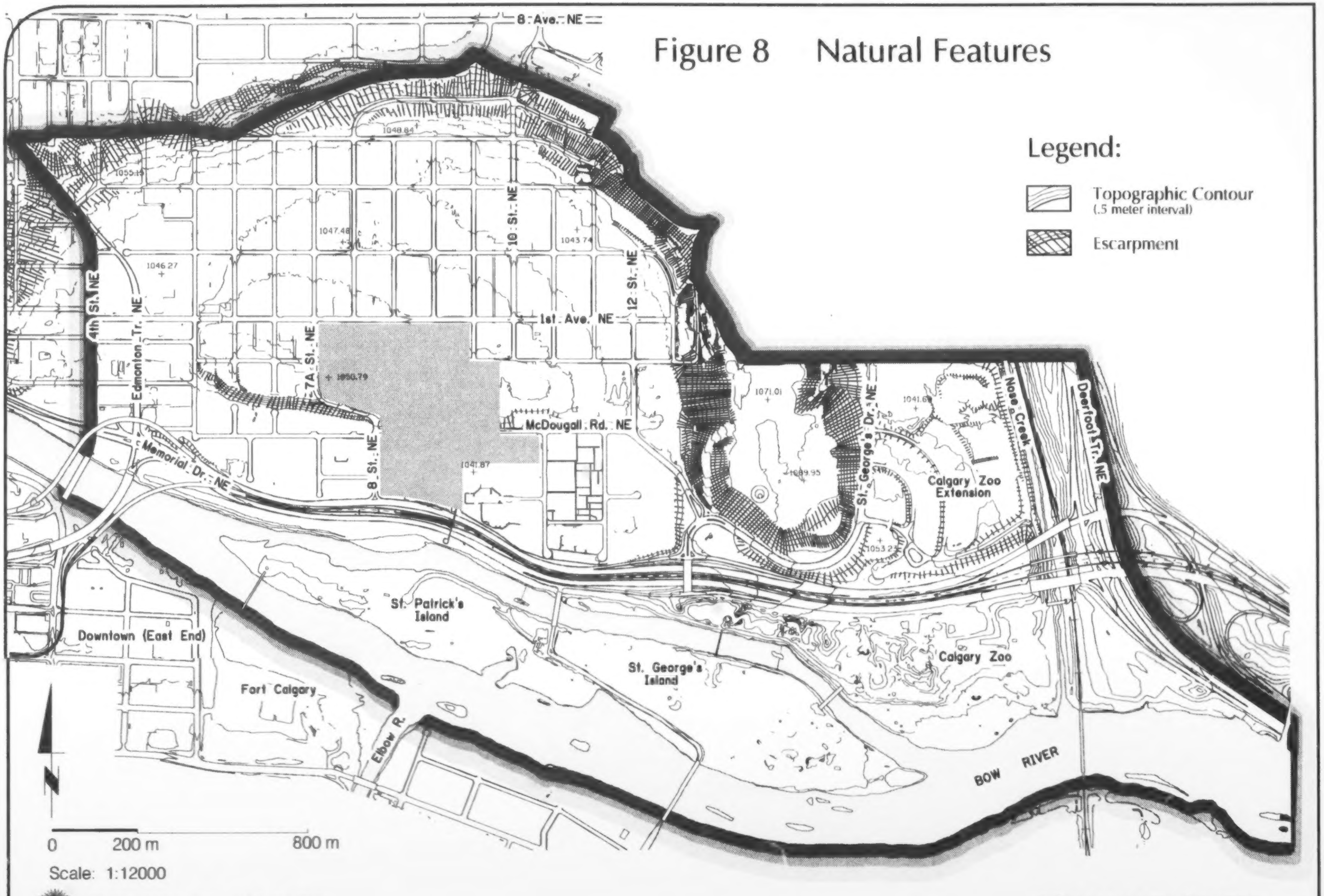
Calgary Board of Education

- Langevin Elementary/Junior High School (107 - 6A Street NE)
  - capacity for 640 students;
  - 1999/00 enrolment of 450 students, including junior high students from Erin Woods who could be assigned to another school if more capacity were required for Bridgeland-Riverside students.
- Bridgeland Elementary School (414 - 11A Street NE)
  - capacity for 175 students;
  - currently surplus to the Board's needs, and leased to the Delta West Academy (private school).
- Christine Meikle School & Activity Centre (64 - 12 Street NE)
  - capacity for 255 students;
  - 1999/00 enrolment of 66 students;
  - serves "special needs" children from all areas of Calgary;
  - no plans to change this function in the foreseeable future.
- Riverside Bungalow School (711 - 2 Avenue NE)
  - the administrative centre for ESL (English as a second language) testing;
  - no plans to change this function in the foreseeable future.

Calgary Catholic School District

- St. Angela Elementary School (231 - 6 Street NE)
  - capacity for 325 students;
  - 1999/00 enrolment of 125 students (kindergarten to grade 6);
  - no plans to close in foreseeable future, in spite of under-utilization;
  - serves only Bridgeland-Riverside children.
- Junior high school students attend St. Alphonsus School in Renfrew
- Senior high school students attend St. Francis Senior High School in Brentwood.

Figure 8 Natural Features


Legend:
Topographic Contour (.5 meter interval)
Escarpment
8 Ave. NE
4th St. NE
Edmonton Tr. NE
7A St. NE
8 St. NE
10 St. NE
12 St. NE
1st Ave. NE
McDougall Rd. NE
Memorial Dr. NE
St. George's Dr. NE
Nose Creek
Deerfoot Tr. NE
Calgary Zoo Extension
Calgary Zoo
St. Patrick's Island
St. George's Island
Downtown (East End)
Fort Calgary
Elbow R.
BOW RIVER
1048.84
1055.15
1047.48
1043.74
1046.27
1050.79
1041.87
1071.01
1089.95
1041.6
1053.2
0
200 m
800 m
Scale: 1:12000

THE CITY OF CALGARY
PLANNING & BUILDING DEPARTMENT

BOW VALLEY CENTRE
REDEVELOPMENT CONCEPT PLAN

4.0 Bow Valley Centre Study Area Profile

4.1 Study Area Topography and Natural Features

The main topographic feature of the BVC site is an escarpment that separates the old Riverside neighbourhood (to the south) from Bridgeland (to the north) and the *Parking Lot* and *Hospital Lands* to the north and northeast (Figure 8). The average 5-metre embankment runs east-west on the north side of McDougall Road. The escarpment drops from an elevation of about 1046 metres to approximately 1041 metres. The lands north of Murdock Road and south of McDougall Road are relatively flat. The area north of Murdock Road representing the *Parking Lot Lands* is at an elevation of about 1050 metres. South of Murdock Road the topography drops off sharply to 1047.5 metres and then flattens for about 25 metres and then resumes a uniform slope down to the McDougall Road.

The height of the escarpment from Murdock Road and 7A Street NE provides spectacular views of the Bow River Valley and the Downtown.

4.2 Ownership of BVC Lands

Following the decision to close the Calgary General Hospital (Bow Valley Centre), The Province of Alberta, the Calgary Regional Health Authority and The City of Calgary established a tri-party agreement regarding the future of the former hospital lands and buildings. The Province was responsible for demolishing the buildings and grading the hospital site. The City was to retain title to the land, free of all title restrictions including those imposed by The Province and the Calgary Regional Health Authority.

4.3 Laundry Building

The Laundry facility provides services to existing Calgary hospitals as well as a limited number of commercial businesses. It will continue to provide services in the current location until 2008. At that time, the laundry operation will relocate to a more suitable industrial location.

4.4 Environmental

Phase 1 and 2 environmental assessments have been completed for the *Parking Lot* and *Hospital Lands*. Results indicate the lands met Alberta Environment Level I criteria suitable for residential development. A Phase I environmental assessment for the *Open Space Lands* is currently under way.

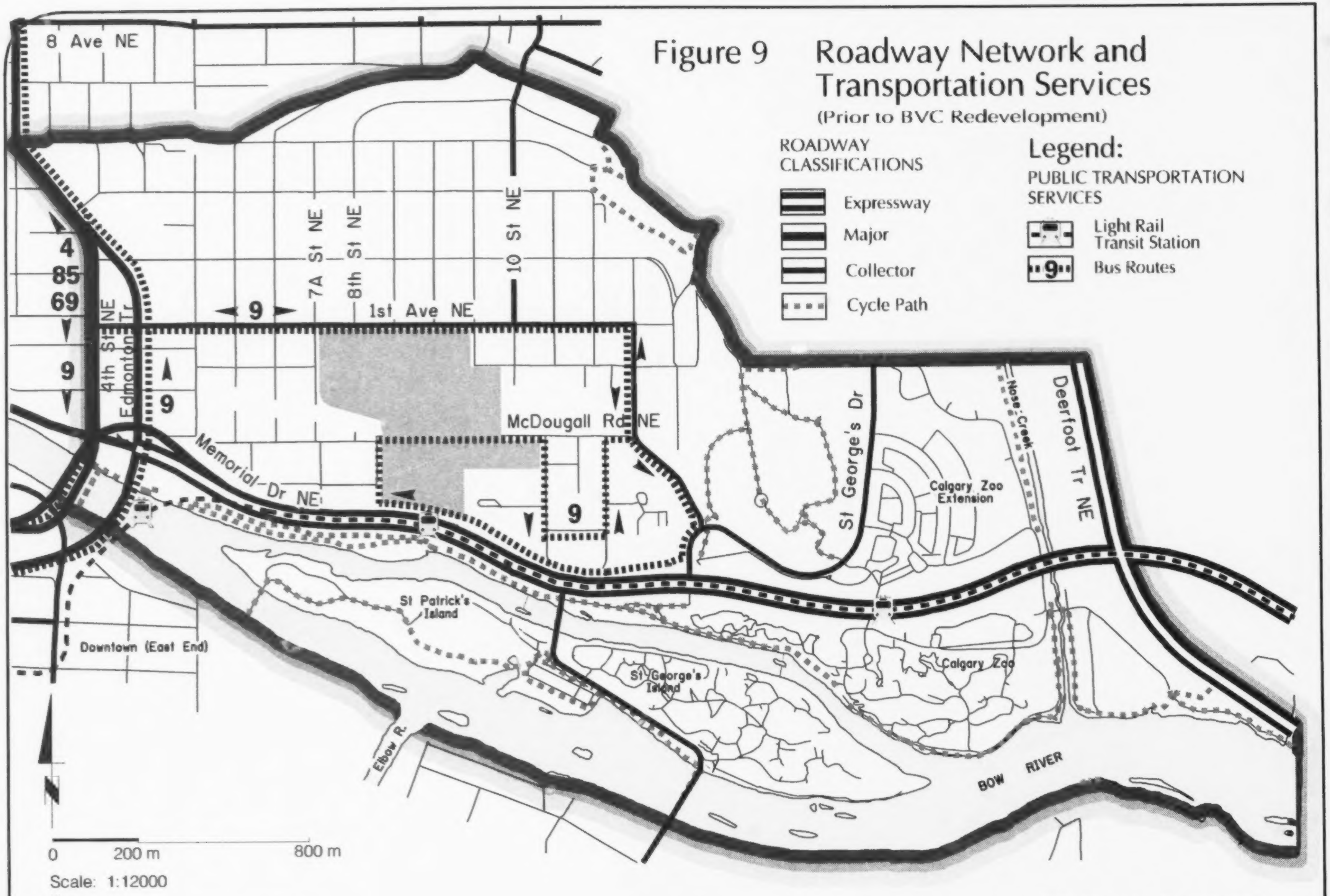
4.5 Existing Transportation System

4.5.1 Roadway Network

As shown in Figure 9, Bridgeland-Riverside has excellent access to the city's roadway network. Both 8 Street NE (right-in, right-out access) and 12 Street NE interchange connect with Memorial Drive, which in turn links with Deerfoot Trail. Deerfoot Trail is the city's primary north-south artery accessing the Calgary International Airport,

Figure 9 Roadway Network and Transportation Services

(Prior to BVC Redevelopment)


ROADWAY CLASSIFICATIONS
Expressway
Major
Collector
Cycle Path
Legend:
PUBLIC TRANSPORTATION SERVICES
Light Rail Transit Station
Bus Routes
8 Ave NE
4
85
69
9
4th St NE
Edmonton Tr
7A St NE
8th St NE
10 St NE
1st Ave NE
McDougall Rd NE
Memorial Dr NE
St George's Dr
Calgary Zoo Extension
Nose Creek
Deerfoot Tr NE
St Patrick's Island
St George's Island
Calgary Zoo
Downtown (East End)
Elbow R.
BOW RIVER
N
0
200 m
800 m
Scale: 1:12000

THE CITY OF CALGARY
PLANNING & BUILDING DEPARTMENT

BOW VALLEY CENTRE
REDEVELOPMENT CONCEPT PLAN

the extensive northeast industrial/commercial district, and the provincial highway network to the north, east and south.

Memorial Drive also provides access to Downtown Calgary via the Langevin Bridge (Edmonton Trail/4 Street NE), to the northwest sector of the city (including the University of Calgary) and to the Trans Canada Highway west to Canmore and Banff. 1 Avenue NE serves as an east-west collector through Bridgeland-Riverside, connecting the Edmonton Trail/4 Street NE couplet and the 12 Street NE interchange. Tenth Street runs north to the community of Renfrew and the Trans Canada Highway (16 Avenue NE), while 12 Street NE interchange provides all-turns access to Memorial Drive and provides direct access to the Calgary Zoo.

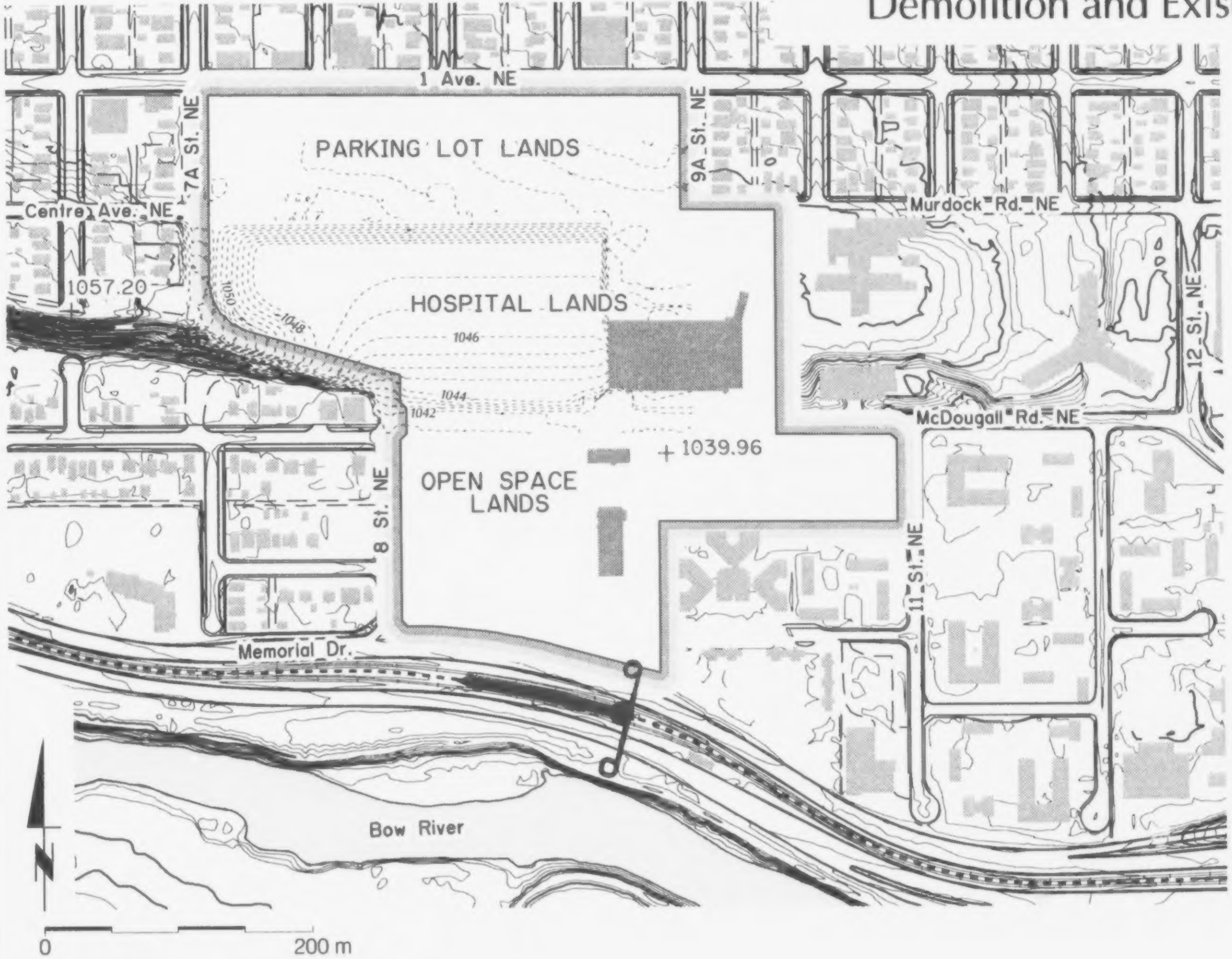
4.5.2 Public Transportation

The community is well served by Calgary Transit, with the Bridgeland LRT Station being the focal point. This is the first station on the northeast LRT line outside the Downtown area, the next one being at the Zoo. The Bridgeland station was particularly effective in serving staff and visitors to the Bow Valley Centre, and with closure of that facility average weekday use at this station is estimated to have dropped from 1,175 to about 635 passengers. Calgary Transit is eager to recoup this lost ridership through redevelopment of the BVC site. LRT service operates at 5-6 minute intervals during weekday peak periods (6:00 - 9:00 AM, 3:00 - 6:00 PM), and every 15 minutes at all other times. The northeast line runs from the Downtown, where free transfers can be made to the south/northwest line, to the Whitehorn station in northeast Calgary. The LRT System provides access at several stations en route to a wide range of commercial and light industrial destinations, as well as to many residential areas of the city.

As shown in Figure 9, Bridgeland-Riverside is also served by Calgary Transit's bus route #9. This route was revised effective September 01, 1997 in response to service demand changes resulting form the Bow Valley Centre closure. In addition to looping through the southeastern portion of the community where seniors' housing predominates, it stops at the Bridgeland LRT Station before returning to 1 Avenue NE. After exiting onto Edmonton Trail/4 Street NE it proceeds south into the Downtown, and then northwest through Kensington/ Hillhurst to the University and Market Mall. Service is every 20 minutes during weekday peak hours, and 30 minutes otherwise. This route utilizes low floor buses to facilitate access by seniors and handicapped.

Calgary Transit also provides north-south bus service along Edmonton Trail/4 Street NE within convenient walking distance of many Bridgeland-Riverside residents. Routes #4 and #69 both provide access to the Downtown, as well as to various areas to the north. Route #4 utilizes low floor buses, and runs at 30 minute intervals at all times, whereas route #69 offers only irregular weekday peak period service with standard buses. A third bus route operating along Edmonton Trial (#85) provides peak period express service between the Huntington Hills area and the Downtown, and does not stop in the Bridgeland-Riverside area.

Figure 10 Proposed Site Grading Following Demolition and Existing Site Topography


1 Ave. NE
PARKING LOT LANDS
HOSPITAL LANDS
OPEN SPACE LANDS
7A St. NE
Centre Ave. NE
9A St. NE
Murdock Rd. NE
12 St. NE
McDougall Rd. NE
11 St. NE
8 St. NE
Memorial Dr.
Bow River
1057.20
1039.96
1050
1048
1046
1044
1042
0
200 m

Scale: 1:4800

Legend:

- ▨ Topographic Contours
- ┄ Proposed Site Grading Contours

NOTE: All contour intervals shown on existing and proposed plans are 0.5 m intervals.

Spot elevations show the lowest elevation and highest elevation.

THE CITY OF CALGARY
PLANNING & BUILDING DEPARTMENT

BOW VALLEY CENTRE
REDEVELOPMENT CONCEPT PLAN

/work/plan/bowvalley/study2.1 05-OCT-2000

4.5.3 Roadway Characteristics

Except for Memorial Drive, all of the public roadways within and adjacent to the study area have rights-of-way of 20.1 metres (66 feet) in width. The bylawed setback of 2.1 metres (7 feet) on either side of 12 Street NE from 1 Avenue NE to St. George's Drive and on 1 Avenue NE from 4 Street NE to 6 Street NE is currently under review. The roadway pavement widths vary from 9.8 metres (32 feet) to 13.4 metres (44 feet). The Bridgeland-Riverside ARP indicates that the setbacks on 1 Avenue NE should continue to be encroached upon. Most roadways in the vicinity of the study area are fairly flat. The only exception, with a gradient of 6.8 percent, is 7A Street NE from Central Avenue NE to McDougall Road NE. This gradient is due to the escarpment west of the study area.

4.5.4 Parking

A variety of curb parking regulations are in effect. For example, along the south side and portions of the north side of 1 Avenue NE, from 7A street to 9A Street NE, a two-hour parking limitation is in effect between the hours of 9:00 AM and 6:00 PM. Detailed information for all streets is available from the Traffic Operations Division of The City's Transportation Department.

4.5.5 Pedestrian Circulation

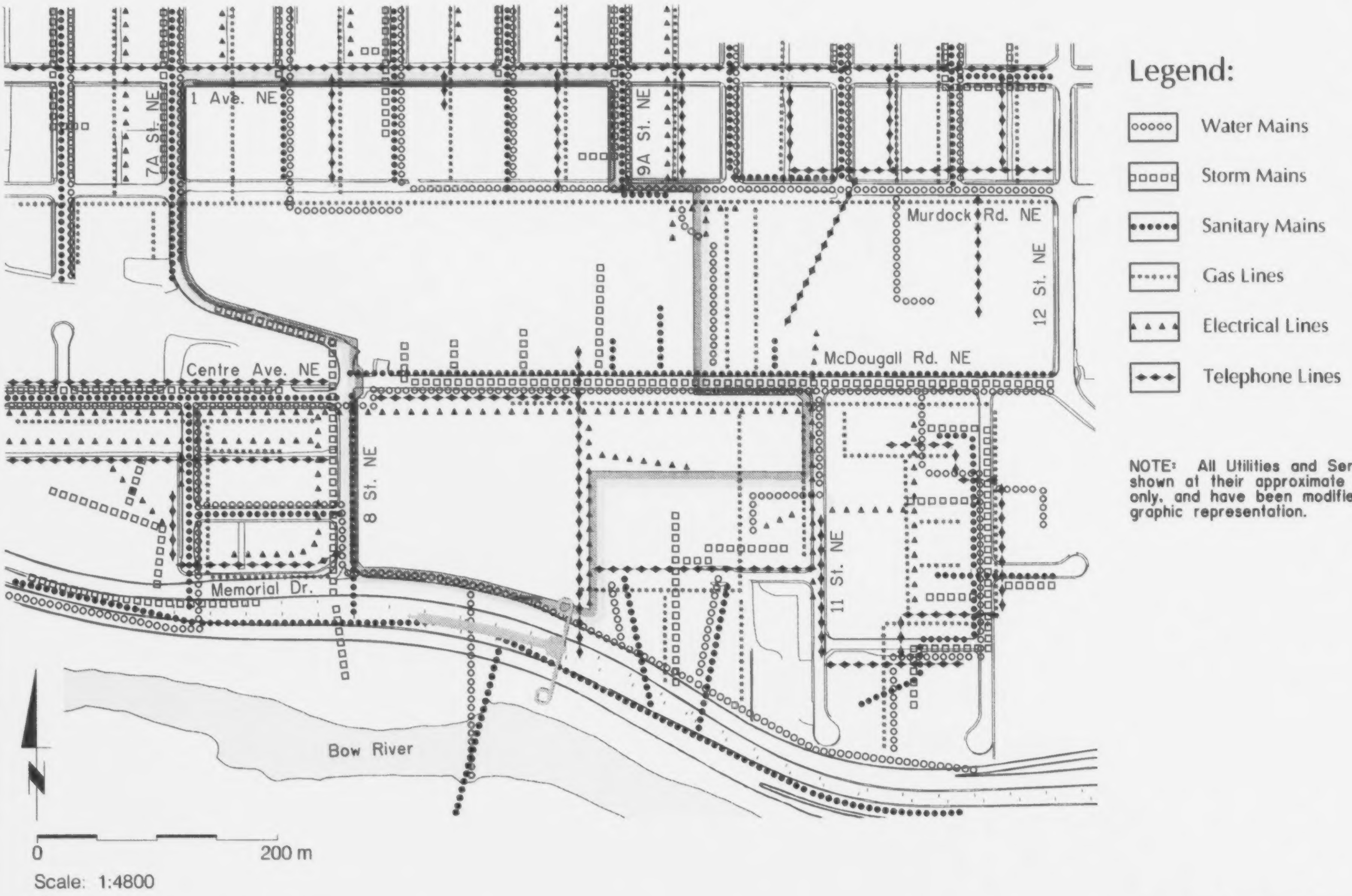
The former Calgary General Hospital was a significant barrier separating Bridgeland from Riverside. Redevelopment of the BVC will re-establish the neighbourhood grid pattern connecting the community north-south and east-west. The Plan will provide direct pedestrian links between the community, the new central park and the Bow River pathway system along with providing a significant, direct connection between 1 Avenue NE and Memorial Drive. This connection, 9 Street NE, will become the "front door" into the community and provides a direct pedestrian connection from the LRT, the Downtown and the Bow River pathway system to the heart of Bridgeland and the 1 Avenue businesses.

4.6 Existing Services and Utilities

4.6.1 Surface Topography and Drainage

The main topographic feature of the site is the average five metre embankment that runs east-west on the north side of McDougall Road. The areas to the north (*Parking Lot Lands* and *Hospital Lands*) and to the south (*Open Space Lands*) of the embankment, are relatively flat. North of the embankment, surface drainage generally flows to the north and east. In close proximity to the embankment, flows are to the south. In the open space south of McDougall Road, surface flows are generally to the east and south. All storm run-off is removed through the storm sewer system. The site of the former hospital has been graded as illustrated in Figure 10.

Figure 11 Servicing and Utilities


1 Ave. NE
7A St. NE
9A St. NE
Murdock Rd. NE
12 St. NE
McDougall Rd. NE
Centre Ave. NE
8 St. NE
11 St. NE
Memorial Dr.
Bow River
0
200 m
Scale: 1:4800
Legend:
Water Mains
Storm Mains
Sanitary Mains
Gas Lines
Electrical Lines
Telephone Lines

NOTE: All Utilities and Services are shown at their approximate locations only, and have been modified for graphic representation.

4.6.2 Servicing and Utilities

Canadian Western Natural Gas advises that there are no high pressure gas lines within or adjacent to the study area, and therefore no building setbacks will be required on this basis. A 42 mm main in McDougall Road, which presently feeds the Regional Laundry and community buildings may have to be abandoned or relocated. The Bow Valley Lodge regulating station located at McDougall Road and 11 Street NE may also have to be relocated.

Discussions with Telus have confirmed that the existing telephone system infrastructure in the area can accommodate whatever pattern of development should occur.

The electrical services in this area are generally compatible with the redevelopment area. Overhead electrical service along McDougall Road NE between 8 Street NE and the east boundary of the *Open Space Lands* may need to be relocated or buried depending upon development decisions.

The existing sanitary, storm sewer, and watermain utilities in the study area may present opportunities for redevelopment through their re-use. Any existing rights-of-way for these utilities that may be re-located would be at the expense of the developer. In the case of re-located watermains, the developer would be required to reinforce the periphery mains to the site to restore the lost capacity of the water main grid. All storm run-off must be contained on each site and directed toward the storm sewer system (Figure 11).

Recent changes to Alberta Environment standards require that stormwater from new developments be treated to provide a cleaner quality of discharge into the Bow River. Redevelopment of BVC will be required to meet these standards and options will be reviewed through detailed site engineering studies.

4.7 Development Constraints

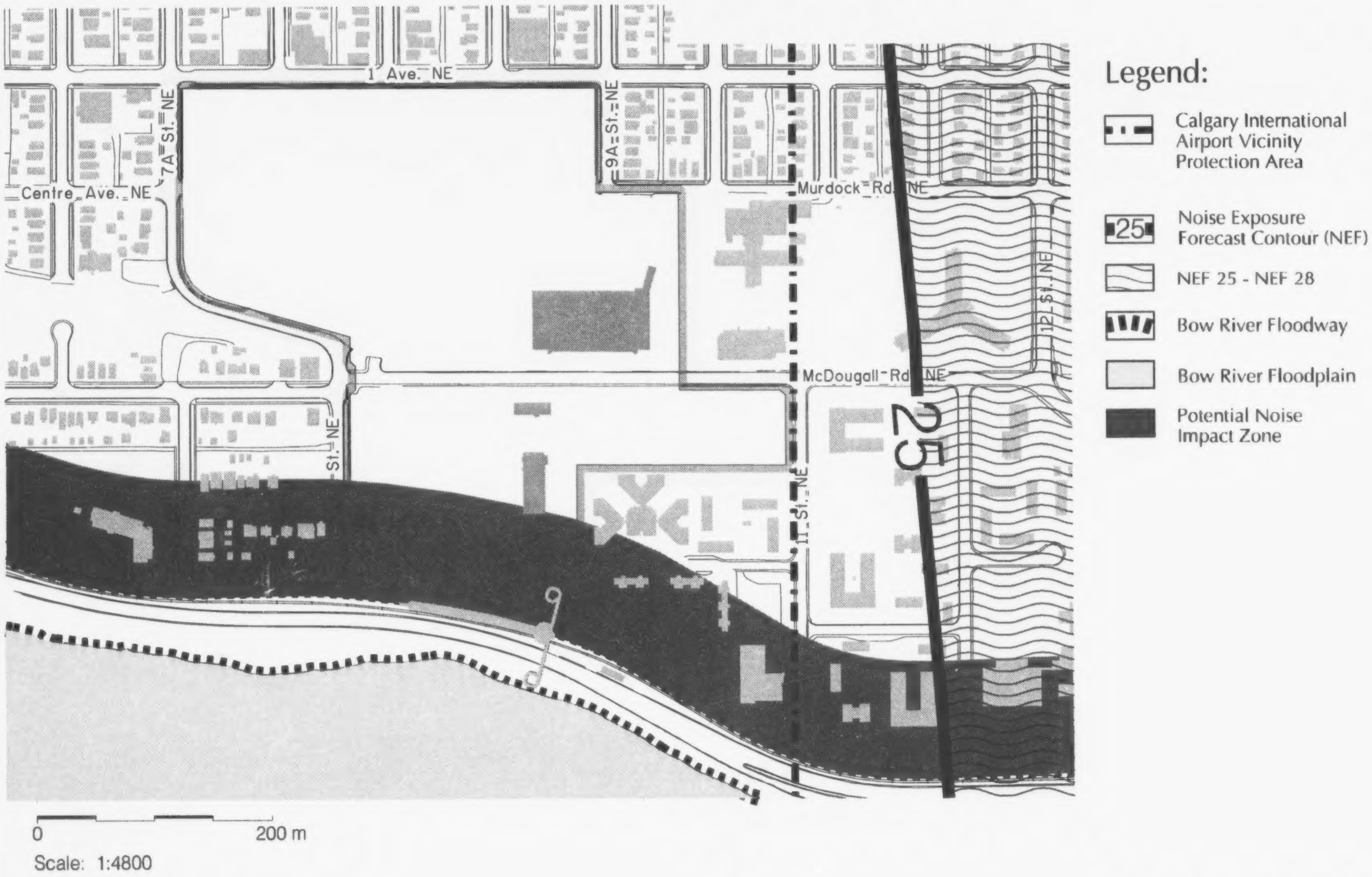
4.7.1 Bow River Floodway and Floodplain

Based on the Canada-Alberta Flood Damage Reduction and Flood Risk Mapping completed in 1993, none of the land within the Bow Valley Centre study area falls within either the floodway or the floodplain of the Bow River. Consequently, redevelopment of the site is unconstrained in this regard. (Figure 12).

4.7.2 Calgary International Airport Vicinity Protection Area

As defined within the Calgary International Airport Vicinity Protection Area Regulation, and as shown in Figure 12, the 25 NEF (noise exposure forecast) contour lies slightly to the east of 11 Street SE, just beyond the eastern boundary of the BVC study area. The 30 NEF contour is further east again. As a result, there are no restrictions under this Regulation on land uses or building height within the study area.

Figure 12 Development Constraints


Legend:
Calgary International Airport Vicinity Protection Area
25 Noise Exposure Forecast Contour (NEF)
NEF 25 - NEF 28
Bow River Floodway
Bow River Floodplain
Potential Noise Impact Zone
1 Ave. NE
Centre Ave. NE
7A St. NE
9A St. NE
Murdock Rd. NE
McDougall Rd. NE
11 St. NE
12 St. NE
St. NE
25
0
200 m
Scale: 1:4800

THE CITY OF CALGARY
PLANNING & BUILDING DEPARTMENT

BOW VALLEY CENTRE
REDEVELOPMENT CONCEPT PLAN

4.7.3 Surface Transportation Noise Attenuation Requirements

In 1983 City Council adopted a Surface Transportation Noise Policy for the City of Calgary. The policy established a design noise level (DNL) of 60 dB(A) Leq(24) for residential land uses adjacent to surface transportation facilities (e.g., roads, heavy rail or light rail transit lines).

In order to implement this policy, potential noise impact zones (PNIZ) were identified relative to roads, as shown below:

Roadway Category	Potential Noise Impact Zone (distance from centre line of roadway)
Major Roads	within 60 metres
Expressways	within 100 metres
Freeways	within 135 metres

The Memorial Drive NE expressway impacts the BVC study area in this regard. As shown on Figure 12, the 100 metre PNIZ impacts a portion of the *Open Space Lands* within the BVC study area, but does not extend into the *Hospital Lands*. With respect to the Northeast LRT line, the policy states that development proposals on adjacent lands will be evaluated on their own merits.

On lands affected by the PNIZ, the developer will be responsible, where technically and economically feasible, for providing noise attenuation necessary to achieve noise levels less than the DNL. Options for noise attenuation include walls, earth berms, distance setbacks, noise insensitive buffer zones (i.e., non-residential uses), orientation of outdoor leisure areas, and various architectural design treatments. In considering proposals for noise attenuation, the Development Authority should take into account aesthetic as well as acoustical criteria.

4.8 Hospital Commemoration

One of the objectives of the planning study, is to investigate the feasibility of providing a commemorative area which recognizes the Calgary General Hospital and its role within the city. Many opportunities exists within the concept plan to provide a commemorative area. The finalization of a hospital commemorative area will be addressed as future site specific development is finalized.

5.0 Policies Affecting the Amendment

5.1 The Calgary Plan (Municipal Development Plan)

The Calgary Plan was adopted by City Council in July 1998 in accordance with the requirements of the Municipal Government Act, 1995. The Calgary Plan is a consolidation of strategic policies including those contained in the Calgary Transportation Plan that will guide the city's growth and development over the long-term to accommodate a population of 1.25 million people. The key land use and transportation planning directions are aimed at greater land use efficiency, reducing the need for vehicle trips, and encouraging transit and other modes of transportation. The Plan seeks to develop a balance between community and environmental quality, mobility, costs and affordability.

The Calgary Plan did not anticipate any significant changes to the BVC site. However, the key policies that affect redevelopment of the site are:

- Encourage sensitive types of housing intensification in all neighbourhoods, in accordance with local plans, to promote a more compact, adaptable form.
- Encourage new housing close to transportation facilities and within mixed-use centres to support transit and pedestrian mobility choices.
- The transit system will offer Calgarians a reasonable alternative to auto travel by:
    - facilitating access to transit for seniors and people with disabilities;
    - integrating transit with other modes of travel.
- The City of Calgary will facilitate mobility for the transportation of disabled and low income persons by:
    - continuing to improve t pedestrian accessibility to transit service;
    - encouraging walking, by including the pedestrian environment as a design element in all land uses and plans for roads, LRT and transit facilities;
    - recognizing cycling as a component of the City's transportation system.

5.2 Bridgeland-Riverside Area Redevelopment Plan

The Bridgeland-Riverside Area Redevelopment Plan (ARP) was adopted by City Council in 1980. In 1988, the Planning & Building Department commenced a review for the Bridgeland-Riverside community. The ARP was amended in 1992 to reflect revisions necessary to make the Plan more relevant and effective in achieving its goals and objectives. To date, the ARP has eight amending Bylaws. The policies that are specifically relevant to redevelopment of the BVC site are:

- To increase residential densities in appropriate locations.
- To implement the policies of the Calgary General Municipal Plan (subsequently replaced by the Calgary Plan).
- To provide opportunities for a wider range of residential alternatives for different age and income levels.
- To provide for the development of a land use pattern that will be better able to be served by public transit.

- To improve the physical environment within the community.
- To develop a more comprehensive strategy dealing with amenities such as recreation and open space.
- To provide for opportunities that would allow for the increased viability of local commercial development catering to residents of the community.
- To conserve and stabilize the family-oriented areas of the community and to ensure their long-term viability.

5.3 Transit Friendly Design Guide

The Transit Friendly Design Guide, approved by City Council in 1995, describes techniques for improved integration of transit into residential and non-residential areas to achieve the vision described in the Calgary Transportation Plan. It explains and gives examples of the physical requirements necessary to encourage transit use.

The BVC Concept Plan and Bridgeland-Riverside ARP amendment is consistent with the principles contained in the Design Guide.

5.4 Inner City Transportation Study

Due to the strategic nature of the Calgary Transportation Plan (CTP) issues relating to inner city roads were not directly addressed. In approving the Plan, Council instructed the Transportation and Planning & Building Departments to prepare Terms of Reference for an inner city transportation study. The objectives of the Inner City Transportation Study (ICTS) were derived within the framework of the CTP. These objectives strike a balance between mobility, cost and community and environment quality. The study area encompasses the BVC site and focuses on the major streets and network collectors within the context of the approved CTP serving the Downtown and inner city areas. The BVC Concept Plan and Bridgeland-Riverside ARP amendment are consistent with the Terms of Reference for the ICTS and findings developed to date.

6.0 Planning and Public Consultation Processes

6.1 Planning and Public Participation Processes

The Bow Valley Centre (former Calgary General Hospital) ceased operation on April 1, 1997. The decision to close this facility was made by the provincially established Calgary Regional Health Authority (CRHA) as part of a series of measures aimed at rationalizing public health services. Closure of the BVC was preceded by the closure of two other Calgary hospitals – the Holy Cross and the Grace.

Figure 13

Bow Valley Centre Redevelopment Project Process

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5
PLANNING PROCESS	Prepare package for proposal call	Receive submissions Evaluate Select 3 - 5 for public review & comment	Preparation of land use concepts Evaluation of concepts	Preparation of preferred land use concept	Preparation of ARP Amendment
PUBLIC INVOLVEMENT PROCESS	Community visioning process Public review & comment on content	Public review & comment on 3 - 5 proposals	Public review & comment on concepts	Public review & comment re: Draft Amendment	Council Public Hearing
	Summer / Fall '98	**Winter '98 / '99**	**Winter / Spring '99**	**Fall '99**	**Spring 2000**

Subsequent to the decision to close the hospital, The City of Calgary established an agreement with the Calgary Regional Health Authority and the Province of Alberta whereby The City was granted clear title of the subject lands. Apart from The Province's responsibility to demolish and grade the site, The City of Calgary assumed sole authority to redevelop the BVC lands.

The Bow Valley Centre Redevelopment project was to carry out a public process to develop a land use concept plan, urban design guidelines and implementation strategies. Terms of Reference for the Bow Valley Centre Redevelopment Concept Plan were approved by City Council on December 15, 1997. The Terms of Reference established a five-phase planning and public involvement process to produce an amendment to the Bridgeland-Riverside Area Redevelopment Plan (ARP). The proposed ARP amendment will incorporate the concept plan into the ARP outlining the existing conditions in the area; issues, concerns and problems perceived to exist; and recommendations for future growth and revitalization directed at improving the quality of life in Bridgeland-Riverside.

Figure 13 depicts the process that the proposed ARP amendment and its associated land use redesignation and outline plan applications followed in being reviewed by the Calgary Planning Commission and City Council at the Public Hearing in late 2000.

All five phases in the planning process included opportunities for public involvement. In total, eight open houses, several smaller public events, and numerous community surveys were conducted (Appendices IV-XI). Throughout the process, a 24-hour information and message phone line, and a web site with email links to The City of Calgary Planning Team were maintained. A newsletter was published on four occasions (included large print and Braille versions). Throughout the planning process, a media strategy helped to ensure the timely release of information to the press and the availability of key team members for interviews.

6.2 Planning Advisory Committee

The Planning Advisory Committee's (PAC) role was threefold:

- Representing a diverse cross-section of public interest (local community, business, city-wide) in the planning process
- Commenting and providing advice to the Planning Team regarding the selection of a preferred concept plan and design guidelines
- Assisting the Planning Team in designing and obtaining public input.

The PAC was comprised of 15 representatives:

- Bridgeland-Riverside Community Association (3)
- Local community residents (4)
- 1 Avenue NE businesses (1)
- Ward 4 Alderman (1)
- City at large representatives (6)

In addition, an independent person from the city at large sat as a volunteer chair for the PAC meetings.

The PAC met a total of 31 times over the course of the planning process.

6.3 Key Stakeholders

As key stakeholders, the Calgary Regional Health Authority (CRHA), the Metropolitan Calgary Foundation (MCF) and the 1 Avenue NE Businesses were all closely involved in the planning process.

The CRHA owns 4.42 hectares (10.92 acres) of land east of the BVC site. This area encompasses the Cross Bow Auxiliary Hospital. Although the Cross Bow Auxiliary Hospital is being phased out of operation, future plans for the facility and site are uncertain.

As previously mentioned, the Metropolitan Calgary Foundation is in the process of intensifying the development of its lands (8.03 hectares/19.85 acres) immediately east of the BVC *Open Space Lands* through the construction of new seniors' facilities.

As the principle local commercial area in the community, the 1 Avenue NE businesses participated in assessing the impact of development on the commercial needs of the community.

7.0 Context for the Concept Plan

7.1 General

The concept plan was developed based on an understanding of the historical forces that lead to the creation of the existing community, an understanding of the present conditions that will influence development and an anticipation of future forces. In short, the concept plan casts an eye not only to the past but is grounded in the present and anticipates the future. Further, the concept plan acknowledges that the context for redevelopment of the site is not only the immediately surrounding community but also the city as a whole. The following points briefly outline the major historical, current and future conditions that will influence redevelopment.

- Historical - The earliest development in Bridgeland-Riverside took place before it was officially part of the young city that was emerging on the south side of the Bow River and before there was even a bridge connecting the two. One of its most significant defining features was its adjacency to the Bow River and Nose Creek Valleys. It was also on the outskirts of a young and growing prairie city which itself was closely tied to the farm and ranchland that surrounded it. The development pattern in the community evolved in response to prevailing conditions that for many years included the presence of the Calgary General Hospital.

- Present - The young prairie city is maturing into a large, multi-faceted community with a population fast approaching one million. Suburban development continues to absorb most of the population growth but at the same time, the Downtown and inner city are experiencing significant levels of redevelopment and intensification. Bridgeland-Riverside is an inner city community well connected to the centre by roads, transit, and walking and cycling paths. At the heart of the community is a 13.61 ha (33.64 ac) redevelopment site where the hospital once stood.

- Future - Calgary is expected to reach a population of 1.25 million people by 2018. The local economy will continue to diversify with a growing role for Calgary as a manufacturing and distribution centre for Western Canada. Downtown and inner city locations will become more attractive as the transportation system continues to experience pressures to keep up with the growth in travel demands. Within the boundaries of the study area, an additional 2,000 - 2,500 people will make Bridgeland-Riverside their home over the next decade. As well, about 900 more seniors will move into the community over the next twenty years on the Metropolitan Calgary Foundation lands. There will also continue to be new development occurring throughout the community as older buildings are replaced with newer ones and low-density development is replaced with higher densities.

APPENDICES

Government of Canada
Gouvernement du Canada

Canada

Numerical Prediction of Aerodynamic Performance of a Complete Aircraft with Contaminated Wings and Flaps

TP 14021E

June 1998

Prepared for

Transportation Development Centre
Transport Canada

by

National Research Council Canada
Institute for Aerospace Research
Aerodynamics Laboratory
Ottawa, Ontario

103-03486/

TP 14021E

Numerical Prediction of Aerodynamic Performance of a Complete Aircraft with Contaminated Wings and Flaps

by
R.S. Crabbe and J. Su
National Research Council Canada
Institute for Aerospace Research
Aerodynamics Laboratory
Ottawa, Ontario

June 1998

This report reflects the views of the authors and not necessarily those of the Transportation Development Centre of Transport Canada.

The Transportation Development Centre does not endorse products of manufacturers. Trade or manufacturers' names appear in this report only because they are essential to its objectives.

Transport Canada Transports Canada

PUBLICATION DATA FORM

1. Transport Canada Publication No.
TP 14021E

2. Project No.
8786 (DC 129)

3. Recipient's Catalogue No.

4. Title and Subtitle
Numerical Prediction of Aerodynamic Performance of a Complete Aircraft with Contaminated Wings and Flaps

5. Publication Date
June 1998

6. Performing Organization Document No.
LTR-A-026

7. Author(s)
R.S. Crabbe and J. Su

8. Transport Canada File No.
ZCD2450-B-14

9. Performing Organization Name and Address
National Research Council Canada
Institute for Aerospace Research
Aerodynamics Laboratory
Ottawa, Ontario
Canada K1A 0R6

10. PWGSC File No.

11. PWGSC or Transport Canada Contract No.

12. Sponsoring Agency Name and Address
Transportation Development Centre (TDC)
800 René Lévesque Blvd. West
Suite 600
Montreal, Quebec
H3B 1X9

13. Type of Publication and Period Covered
Final

14. Project Officer
Barry B. Myers

15. Supplementary Notes (Funding programs, titles of related publications, etc.)
Co-sponsored by Natural Research Council Canada's Institute for Aerospace Research (NRC/IAR)

16. Abstract

Numerical analyses have been carried out on the aerodynamics of a complete aircraft with contaminated wings and flaps. The numerical method is based on an interactive boundary layer approach that involves interaction between the inviscid potential and viscous boundary layer solutions. The potential flow is obtained by using a low-order panel method while the boundary layer solution is obtained by solving the three dimensional integral boundary layer equations in a streamline coordinate system. The rough surface skin-friction relations of Dvorak (1969), which incorporate both surface roughness height and density, are used to deal with the contamination effects. A computer code, PMAL3D, has been developed for carrying out the numerical calculations.

Predictions by PMAL3D are in very close agreement with experimental data for clean surface cases with or without ground effect. Computational results and discussion are further given for the influence of contamination on total lift of a configuration. In terms of total lift loss, PMAL3D predicts results in agreement with the experiment.

17. Key Words
Aerodynamic modelling, contaminated take-off, aerodynamic behaviour, roughness, lift loss, flow separation

18. Distribution Statement
Limited number of copies available from the Transportation Development Centre

19. Security Classification (of this publication)	20. Security Classification (of this page)	21. Declassification (date)	22. No. of Pages	23. Price
Unclassified	Unclassified	—	x, 20, app.	Shipping/ Handling

CDT/TDC 79-005
Rev. 96

Canada

Transports Canada Transport Canada

FORMULE DE DONNÉES POUR PUBLICATION

1. N° de la publication de Transports Canada
TP 14021E

2. N° de l'étude
8786 (DC 129)

3. N° de catalogue du destinataire

4. Titre et sous-titre
Numerical Prediction of Aerodynamic Performance of a Complete Aircraft with Contaminated Wings and Flaps

5. Date de la publication
Juin 1998

6. N° de document de l'organisme exécutant
LTR-A-026

7. Auteur(s)
R.S. Crabbe et J. Su

8. N° de dossier - Transports Canada
ZCD2450-B-14

9. Nom et adresse de l'organisme exécutant
Conseil national de recherches du Canada
Institut de recherche aérospatiale
Laboratoire d'aérodynamique
Ottawa, Ontario
Canada K1A 0R6

10. N° de dossier - TPSGC

11. N° de contrat - TPSGC ou Transports Canada

12. Nom et adresse de l'organisme parrain
Centre de développement des transports (CDT)
800, boul. René-Lévesque Ouest
Bureau 600
Montréal (Québec)
H3B 1X9

13. Genre de publication et période visée
Final

14. Agent de projet
Barry B. Myers

15. Remarques additionnelles (programmes de financement, titres de publications connexes, etc.)
Coparrainé par l'Institut de recherche aérospatiale du Conseil national de recherches du Canada (CNRC/IRA)

16. Résumé

Des analyses numériques ont permis de caractériser les propriétés aérodynamiques d'un aéronef en vraie grandeur dont les ailes et les volets sont contaminés. La méthode d'analyse utilisée s'appuie sur une vision interactive de la couche limite, laquelle pose l'existence d'une interaction entre les solutions d'écoulement potentiel non visqueux et de couche limite visqueuse. La solution d'écoulement potentiel est obtenue à l'aide d'une méthode des panneaux d'ordre faible, tandis que celle de la couche limite découle de la résolution des équations intégrales tridimensionnelles de la couche limite, dans un système de coordonnées qui définit la ligne de courant. Les relations de Dvorak (1969) touchant la traînée due au frottement, qui font intervenir l'épaisseur et la densité des rugosités de la surface, ont servi à l'étude des effets de la contamination. Enfin, un code machine, le PMAL3D, a été mis au point aux fins des calculs numériques.

Les prévisions faites à l'aide du PMAL3D sont étroitement corrélées avec les résultats d'expériences réalisées sur des surfaces propres, avec ou sans effet de sol. Le rapport contient également des résultats de calculs assortis de commentaires sur les effets de la contamination sur la portance totale d'une configuration. Pour ce qui est de la perte de portance totale, les résultats issus du code PMAL3D concordent avec les données expérimentales.

17. Mots clés
Modélisation aérodynamique, décollage d'un aéronef contaminé, comportement aérodynamique, rugosité, perte de portance, séparation de l'écoulement

18. Diffusion
Le Centre de développement des transports dispose d'un nombre limité d'exemplaires.

19. Classification de sécurité (de cette publication)	20. Classification de sécurité (de cette page)	21. Déclassification (date)	22. Nombre de pages	23. Prix
Non classifiée	Non classifiée	—	x, 20, ann.	Port et manutention

CDT/TDC 79-005
Rev. 96

Canada

ACKNOWLEDGEMENTS

This work was supported by Transport Canada. The authors wish to thank Messrs. Frank Eyre and Barry Myers of the Transportation Development Centre for their helpful discussions and cooperation.

TABLE OF CONTENTS

Introduction.......... 1

Methodology.......... 2

Case Studies.......... 4

Conclusions and Recommendation.......... 6

References.......... 7

Appendix A

LIST OF FIGURES

Figure 1 Representation of the geometry of Fokker F28 M1000 aircraft by surface panels..... 9

Figure 2 Lift coefficient of Fokker F28 M1000 configuration with 18 deg flap deflection. $U_\infty = 70$ m s^{-1}; free air with no ground effect 10

Figure 3 Lift coefficient of Fokker F28 with 18 deg flap deflection. $U_\infty = 57.8$ m s^{-1}; ground effect included with and without roughness; roughness height $k = 1.0$ mm, roughness density parameter $\lambda = 5.0$ 11

Figure 4 Comparison of the lift coefficient of F28 with clean and contaminated wing/flap. $k = 1.0$ mm, $\lambda = 5.0$ 12

Figure 5 Comparison of the lift coefficient of F28 with different roughness heights and densities 13

Figure 6 Influence of leading and trailing edge contaminations on the lift coefficient of F28 14

Figure 7 Influence of leading and/or trailing edge contaminations on the lift coefficient of F28. $k = 1.0$ mm, $\lambda = 5.0$ 15

Figure 8 Effect of practical contamination conditions on the lift coefficient 16

Figure 9 Influence of laminar/turbulent transition on the lift coefficient (no roughness) 17

Figure 10 An assumed contamination pattern for roughness studies 18

Figure 11 A practical contamination pattern with 20% failure. A-D: $k = 1.0$ mm, $\lambda = 8.0$; E: $k = 0.5$ mm, $\lambda = 50.0$ 18

Figure 12 A practical contamination pattern with 75% failure. A-C: $k = 1.0$ mm, $\lambda = 8.0$; E-H: $k = 0.2$ mm, $\lambda = 800.0$; I: $k = 0.4$ mm, $\lambda = 50.0$; D, J: $k = 0.5$ mm, $\lambda = 35.0$ 19

Figure 13 A practical case of snow deposit on a parked F28 M1000 aircraft........ 20

LIST OF SYMBOLS

C_f = skin-friction coefficient
C_L = lift coefficient
e = entrainment constant
H = shape factor of streamwise velocity profile, δ_1^* / θ_{11}
$H_{\delta-\delta_1^*}$ = entrainment shape factor of streamwise velocity profile, $(\delta - \delta_1^*)/\theta_{11}$
k = roughness height
n = crossflow coordinate
s = streamline coordinate
u = streamwise boundary-layer velocity component
U = resultant velocity at boundary layer edge
U_∞ = undisturbed freestream velocity
v = crossflow boundary-layer velocity component
α = angle of attack
β = angle between an external streamline and corresponding limiting streamline
γ = streamline direction with respect to x
δ = boundary layer thickness
δ_1^*, δ_2^* = streamwise and crossflow displacement thicknesses
λ = roughness density parameter
θ_{ij} = boundary layer momentum thicknesses
ζ = coordinate in the normal direction to surface

INTRODUCTION

A number of fatal aircraft accidents during the last 15 years, occurring at take-off during periods of freezing precipitation, have directed considerable attention to the investigation of roughness effects of contamination on the aerodynamic performance of aircraft (Luers, 1983, Boer, 1991 and Kind and Lawrysyn, 1992). Protection of aircraft surfaces against adhesion and accumulation of freezing precipitation is currently achieved by application of freezing point depressant fluids (anti-icing fluids) for the brief period of taxi and take-off. In practice, take-off occurs when the pilot is satisfied that the critical surfaces are free from contamination. The practical method to accomplish this is by visual inspection, which is frequently difficult due to aircraft geometry and/or adverse lighting conditions. Under these circumstances it is possible that take-off may be attempted with surfaces that are contaminated by the adhesion of freezing precipitation which passed undetected or were non-existent at the time of pilot's final inspection. The contamination may not be uniform. Recent investigations into aircraft accidents where freezing precipitation buildup on the surfaces was deemed to be a factor, have assumed that the ground effect on aircraft aerodynamics was also a factor. The present work has investigated the influence of contamination on the aircraft aerodynamic performance with ground effect included.

Research work has been being carried out on this issue for several years at the Aerodynamics Laboratory, IAR/NRC. A two-dimensional computer code was first developed by Crabbe (1995), and later extended to three-dimensional wings (Crabbe, 1998) resulting in an earlier version of PMAL3D. PMAL3D has been shown (Crabbe, 1998) to predict inviscid wing lift to the accuracy of a commercial panel code, PMARC, which is to be expected inasmuch as both methods are low order using uniform source and doublet distributions on each surface panel. PMARC, which has been applied to compute inviscid flow about a complete aircraft (Edge and Perkins, 1995), is the potential portion of an earlier commercial code VSAERO. VSAERO contains a boundary layer code (for clean surfaces) that is specialized to the swept wing of infinite span. Consequently, it is only approximately valid for finite-span-wing aircraft. PMAL3D. On the other hand, it predicts viscous flow about general aircraft configurations with or without contaminated surfaces. Navier-Stokes solutions for multi-element airfoils and wings have been reported in the literature (e.g. Cebeci, 1997). While these methods automatically include viscous effects, the authors are not aware of any Navier-Stokes code that will treat three-dimensional aircraft surfaces with arbitrarily distributed roughness. Results reported in this paper demonstrate, however, that interactive panel codes, such as PMAL3D, can be readily adapted to aircraft surfaces with arbitrary patterns of both roughness height and spacing. PMAL3D not only predicts lift coefficients up to the onset of stall but can also predict the effect of slideslip on wing lift. However, this paper discusses the pre-stall lift loss of the wing-flap-fuselage-tail configuration of the F28M1000 aircraft due to roughness in coordinated flight.

METHODOLOGY

In the viscous-inviscid interaction technique, separate calculations of the inviscid outer flow and the viscous inner flow are matched by an iterative procedure to yield a solution to the problem. The numerical method used in the present work employs this technique and involves interaction between the inviscid potential solution for the outer flow and the boundary layer solution for the inner flow. A potential solution is obtained by using a panel method while the boundary layer solution is obtained by solving three-dimensional integral boundary layer equations. This method has been demonstrated to be very efficient with little loss in accuracy for a broad range of applications to the external aerodynamics of aircraft.

Integral prediction methods for three-dimensional turbulent boundary layers are most readily described in a streamline coordinate system (*s*, *n*) on the body surface with *s* being in the streamwise direction and *n* being the normal direction to the streamline. The integral equations in this coordinate system are

s momentum integral equation:

$$\frac{\partial\theta_{11}}{\partial s}+\frac{\partial\theta_{12}}{\partial n}+\frac{\theta_{11}}{U}\frac{\partial U}{\partial s}(2+H)+\frac{\partial\gamma}{\partial n}(\theta_{11}-\theta_{22})=\frac{C_f}{2} \qquad (1)$$

n momentum integral equation:

$$\frac{\partial\theta_{21}}{\partial s}+\frac{\partial\theta_{22}}{\partial n}+\frac{2}{U}\frac{\partial U}{\partial s}\theta_{21}+\frac{\theta_{11}}{U}\frac{\partial U}{\partial n}(1+H+\frac{\theta_{22}}{\theta_{11}})+2\frac{\partial\gamma}{\partial n}\theta_{21}=\frac{C_f}{2}\tan\beta \qquad (2)$$

entrainment equation:

$$\frac{\partial(\delta-\delta_1^*)}{\partial s}-\frac{\partial\delta_2^*}{\partial n}=F(H_{\delta-\delta_1^*})-(\delta-\delta_1^*)[\frac{\partial U}{U\partial s}+\frac{\partial\gamma}{\partial n}(1-e)] \qquad (3)$$

where $\partial\gamma/\partial n$ is streamline divergence. Crabbe (1977) has shown that $e=0.5$ in diverging flow ($\partial\gamma/\partial n>0$) and 0.1 in converging flow ($\partial\gamma/\partial n<0$). $F(H_{\delta-\delta_1^*})$ is Head's entrainment function. The displacement and momentum thicknesses are given by

$$\delta_1^*=\int_0^\delta(1-\frac{u}{U})d\zeta\,, \qquad \delta_2^*=-\int_0^\delta\frac{v}{U}d\zeta$$

$$\theta_{11}=\int_0^\delta\frac{u}{U}(1-\frac{u}{U})d\zeta\,, \qquad \theta_{12}=\int_0^\delta\frac{v}{U}(1-\frac{u}{U})d\zeta$$

$$\theta_{21}=-\int_0^\delta\frac{uv}{U^2}d\zeta\,, \qquad \theta_{22}=-\int_0^\delta\frac{v^2}{U^2}d\gamma \qquad (4)$$

Mager's form for the crossflow

$$\frac{u}{v}=\left(1-\frac{\zeta}{\delta}\right)^{2}\tan\beta$$

and Cumsty and Head's form for the streamwise velocity profile,

$$\frac{u}{U}=\left(\frac{\zeta}{\delta}\right)^{\frac{H-1}{2}} \qquad (5)$$

are used here. Equations (4) and (5) enable the crossflow integral thicknesses to be simply expressed as functions of H, θ_{11}, and tan β.

The roughness effect of the contamination is simulated using the formulation developed by Dvorak (1969). In the present paper, the method has been applied to a complete aircraft where the main lifting surfaces (wing and flap) are contaminated by distributed roughness which arises when applications of anti-icing fluid fail to prevent local adhesion of freezing precipitation to these surfaces. The equation for the skin friction coefficient is expressed in terms of roughness height k and dimensionless spacing λ as

$$C_f=C_f\left(H,\theta_{11},k,\lambda\right) \qquad (6)$$

The details of this equation are given in Dvorak (1969).

The numerical integration of the above equation set is implemented along streamlines. Each streamline is divided into N subdivisions (25 for the wing and 15 for the flap for the results presented in this paper). Each subdivision is divided into four equal sections. A fourth order Runge-Kutta method is used to advance the numerical solution to the three-fourths point. The solution is then advanced to the end of the subdivision using the Adams-Bashforth-Moulton predictor-corrector method. The overall scheme is therefore a mix of explicit and implicit operations and has proven to be efficient and robust. Equations (1) to (3) are solved using the above scheme along two streamlines, one on each of the upper and lower surfaces of the wing or flap, in each of the chordwise strips, starting at the flow attachment line. Two nested computational loops are used. The outer loop is between the potential flow solution and the boundary layer flow solution while the inner loop for the boundary layer flow begins by ignoring orthogonal derivatives of the crossflow integrals and then follows by including them in the second and higher iterations.

CASE STUDIES

Figure 1 shows the geometry of a Fokker F28 MI000 aircraft and the surface paneling used in the calculations. In total, 1740 panels are used for the half-configuration with 710 panels covering the wing and flap. The tail-fin is not included since its aerodynamic influence is negligible for a symmetric aircraft configuration under zero sideslip angle investigated here.

The lift coefficient of the Fokker F28 is presented in Figure 2. The upstream flow speed is equal to 70 m s^{-1}; Reynolds number at the mean chord is 17.5 million and no ground effect is included (free air). It has been shown that the potential solution obtained by PMAL3D is in very good agreement with the PMARC potential solution in Crabbe (1998). With the three-dimensional boundary layer included, PMAL3D therefore yields results close to the experimental data with clean surfaces (Morgan et al, 1989). The wing root angle of attack is 3.7 degrees higher than that of the fuselage (reference) angle of attack which is used in the second and subsequent figures, but the wing is twisted so that the tip flies at an angle of attack 3.9 degrees lower than the root.

Figure 3 shows similar results in ground effect. The upstream flow speed is 57.8 m s^{-1}; Reynolds number at the mean chord is 14.5 million. The leading edge of the root chord of the gross wing is two meters above ground. These conditions are close to the take-off scenario of the Fokker F28 M1000. Again the lift coefficient calculated by PMAL3D is in excellent agreement with the clean surface experimental data (Morgan et al, 1989). The roughness result obtained by simulating a contaminated wing and flap by PMAL3D is also presented in Figure 3. It is assumed that the whole wing upper surface and that part of the flap upper surface not hidden by the wing planform are contaminated. The roughness height is k =1.0 mm and density parameter (nondimensional roughness spacing), λ =5.0. An example of the use of k and λ to specify the physical properties of surface roughness is given in the appendix. Use of k =1.0 mm with λ =5.0 is a very severe contamination case at take-off. It is seen that even at a small angle of attack (0.0-6.0 degrees) without flow separation the lift of the configuration drops by about 10%. Obviously, the contamination effect is quite substantial for this case. The results for k =1.0 mm and λ =50.0 (lower roughness density than that with λ =5.0) are given in Figure 4. Oleskiw and Penna (1997) have done wind tunnel measurements for a similar wing/flap configuration. The roughness condition for this case is quite close to the wind tunnel test carried out by them. From Figure 4, it is observed that the lift coefficient is reduced by about 5% by the roughness. This is quite a reasonable estimate of the effect of a rough surface on the lift according to the experimental data of Oleskiw and Penna (1997).

The results with different roughness heights and/or density parameters are presented in Figure 5. It is observed that the reduction in lift coefficient is not linearly related to k and/or λ. For instance, increasing k from 1.0 mm to 1.5 mm has not resulted in decreasing the lift coefficient significantly. In fact, the difference is quite small. However, further numerical investigation is required before a sound conclusion can be made.

In most practical situations, the contamination is localized at leading and/or trailing edges. Numerical results are also performed for this type of distribution. Figure 6 presents the results with 10% leading and 10% trailing edge contamination as shown in Figure 10. The roughness height is k=1.0 mm and the density parameter λ=5.0. At angles of attack less than 2.0 degrees, the roughness of contamination has a very small effect on the lift. As the angle of attack increases the effect increases and at 6.0 degrees the lift is reduced by about 6%. The predictions with leading or trailing edge contamination alone are given in Figure 7. It is noticed that with either leading or trailing edge contamination the roughness effect is quite small; but the combination of them has greater influence on the lift. This result may mean that it is the total area of contamination that matters as long as there is no flow separation occurring.

For a typical contamination condition with 20% failure at take-off shown in Figure 11, the numerical prediction is given in Figure 8. It is evident that the roughness effect of the contamination is negligible up to 4.0 degrees of angle of attack. The numerical result for a contamination condition with 75% failure (Figure 12) is also presented in Figure 8. The difference between 20% and 75% failures is negligible.

Results were also computed for the practical case of the effect of snow on the lift characteristics of the F28 aircraft parked in a crosswind. The contaminant pattern for the leeward wing is shown in Figure 12. The contaminant pattern for the windward wing is not shown since it is only involves the lift spoilers where the roughness height is essentially 0.65 mm (compared with 1.0 mm on the leeward wing). The lift curves in take-off configuration (flap deflected 18 degrees from its stowed position) for the clean and contaminated aircraft are plotted on Figure 13 where it is seen that they are almost identical up to an angle of attack of six degrees. The maximum lift coefficients of the contaminated wings occur at 7.53 degrees where the lift coefficient of the leeward wing is slightly less than that of the windward wing, 1.509 vs. 1.510. This difference gives rise to a negligible rolling moment coefficient of -3×10^{-7} which is easily offset by aileron deflection. The overall effect on lift of this roughness pattern is small since the computed boundary-layer thickness in the region of maximum roughness height is 16 cm., or about 160 times the roughness height, at eight degrees angle of attack. Moreover, some of the snow could be expected to blow off during take-off thereby reducing the lift loss.

The roughness effect of contamination has been discussed above without flow separation occurring. However, the contamination may trigger earlier separation than without contamination, which could subsequently reduce the total lift of the configuration significantly even for the case shown in Figure 11. Thus, flow separations induced by contamination should be investigated for more comprehensive discussion of roughness effect of contamination. PMAL3D at the present stage of development can only handle cases without separated flow, although it does predict the boundary-layer separation line. (Cumpsty and Head, 1967, and Crabbe, 1998). Further extension to separated flows is obviously of importance for both practical applications and research purposes.

PMAL3D can also model a laminar boundary layer with a criterion for laminar/turbulent transition following the approach of Cebeci and Bradshaw (1977). The result with laminar/turbulent transition is compared with the fully turbulent result in Figure 9. It is noticed that the difference is negligible. Therefore approximating the whole boundary layer as being turbulent is reasonable for the configuration examined here.

CONCLUSIONS AND RECOMMENDATION

A numerical method and discussions of its results have been presented on the aerodynamics of Fokker F28M1000 aircraft with contaminated wings and flaps. A computer code, PMAL3D, has been developed for carrying out the numerical calculations.

Predictions by PMAL3D are in very close agreement with experimental data for clean surface cases with or without the ground effect. The influence of contamination on total lift of the F28M1000 aircraft is discussed by choosing different contamination patterns with different roughness parameters. It is noticed that under certain conditions, even at small angles of attack and without separation, the roughness effect of contamination on the aerodynamics of aircraft can be significant. In terms of total lift loss, the PMAL3D prediction is very promising according to the experimental data of Oleskiw and Penna (1997).

The roughness effect of contamination without flow separation has been studied in this report. For more comprehensive analyses the separations induced by contamination should be investigated.

REFERENCES

Boer, N., 1991, "Effect of Hoar-Frosted Wings on Fokker 50 Take-Off Characteristics," *AGARD 68th Fluid Dynamics Panel Specialists Meeting on Effects of Adverse Weather on Aerodynamics,* Toulouse, France.

Cebeci, T., 1997, "An Efficient and Accurate Approach for Analysis and Design of High Lift Configurations," *Proceedings of the 6th Aerodynamics Symposium,* April 28-30, Toronto, Ontario, Canada, pp. 65-80.

Cebeci, T. and Bradshaw, P., 1977, *Momentum Transfer in Boundary Layers,* Hemisphere Publishing Corporation, London, pp. 281-314.

Crabbe, R.S., 1977, "A Contribution to the Study of Uniformly Diverging and Converging Turbulent Boundary Layers," Ph.D Disssertion, McGill Univ., Montreal. PQ, Canada.

Crabbe, R.S., 1995, "Predicted Influence of Surface Roughness Including Fluid-Runback Waves on Airfoil Lift and Drag," *Report LTR-A-002,* IAR/NRC.

Crabbe, R.S., 1998, "A Simple Numerical Method to Compute Viscous Lift Loss of Wings," *Journal of Aircraft,* Vol.35, No.l, pp. 27-32.

Cumsty, N.A. and Head, M.R., 1967, "The Calculation of Three-Dimensional Turbulent Boundary Layers," *The Aeronautical Quarterly,* February, pp. 55-84.

Dvorak, F.A., 1969, "Calculation of Turbulent Boundary Layers on Rough Surfaces in Pressure Gradient," AIAA *Journal,* Vol. 7, No. 9, pp 1752-1759.

Edge D.C. and Perkins, J.N., 1995, "Three-Dimensional Aerodynamic Analysis of a Subsonic High-Lift Transport Configuration Using PMARC," AIAA *95-0039.*

Luers, J.K., 1983, "Wing Contamination: Threat to Safe Flight," *Astronautics and Aeronautics,* pp. 54-59.

Kind, R.J. and Lawrysyn, M.A., 1992, "Performance Degradation due to Hoar Frost on Lifting Surfaces," *Canadian Aeronautics and Space Journal,* Vol. 38, No.2.

Morgan, J.M., Wagner, G.A., and Wickens, R.H., 1989, "A Report on the Flight Dynamics of the Fokker F-28 Mk1000 as They Pertain to the Accident at Dryden, Ontario, March, 1989," Appendix 4 of the Final Report, Commission of Inquiry into the Air Ontario Crash at Dryden, Ontario. The Honourable Virgil P. Moshansky, Commissioner.

Oleskiw, M. M. and Penna, P.J., 1997, "Wind Tunnel Wing Section Performance with De/Anti-Icing Fluids and Freezing Precipitation," *SAE Aircraft Ground Deicing Conference,* Pittsburgh, Pennsylvania, June 11-13.

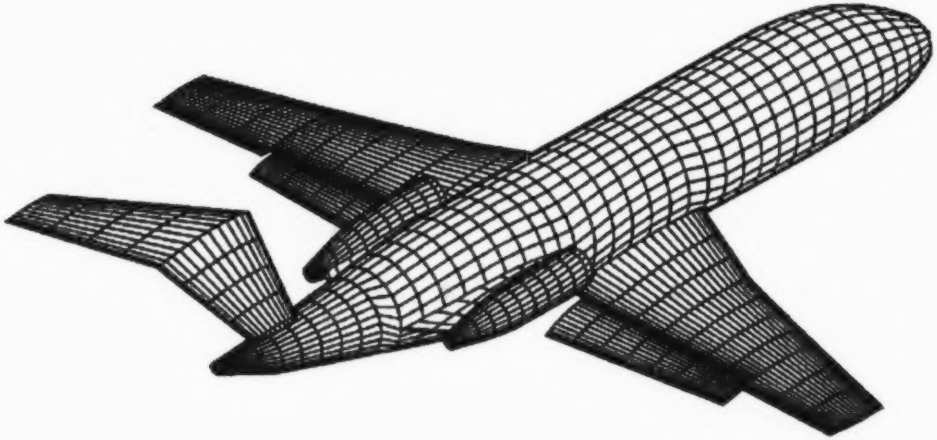


Figure 1 Representation of the geometry of the Fokker F28 M1000 aircraft by surface panels.

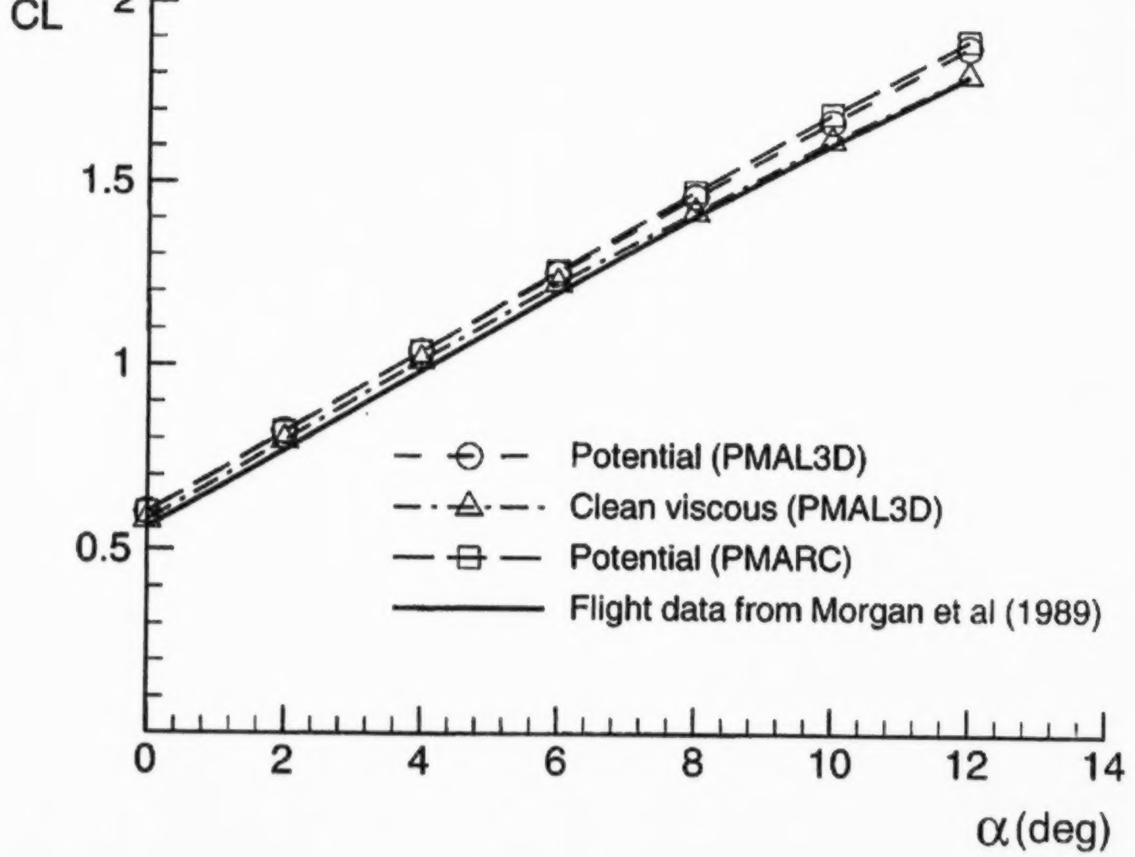


Figure 2 Lift coefficient of the Fokker F28 with an 18 deg flap deflection
Free air with no roughness.

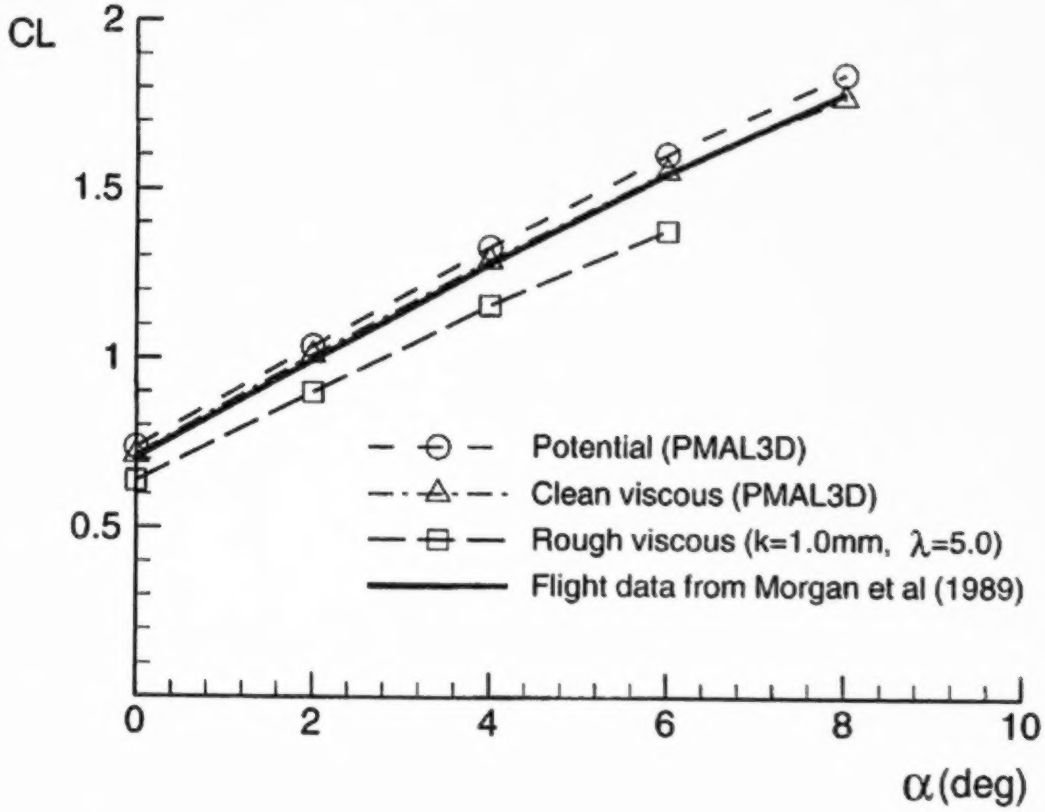


Figure 3 Lift coefficient of the Fokker F28 with an 18 deg flap deflection. Ground effect with and without roughness.

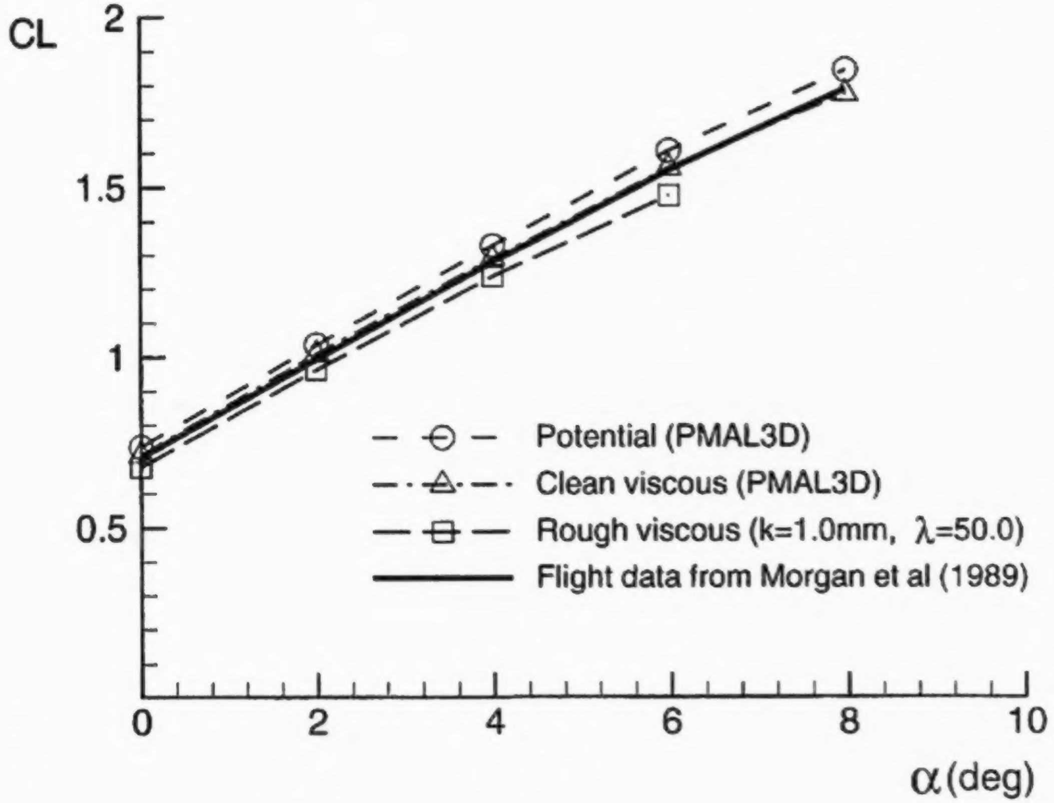


Figure 4 Comparison of the lift coefficient of the F28 with clean and contaminated wing/flap.

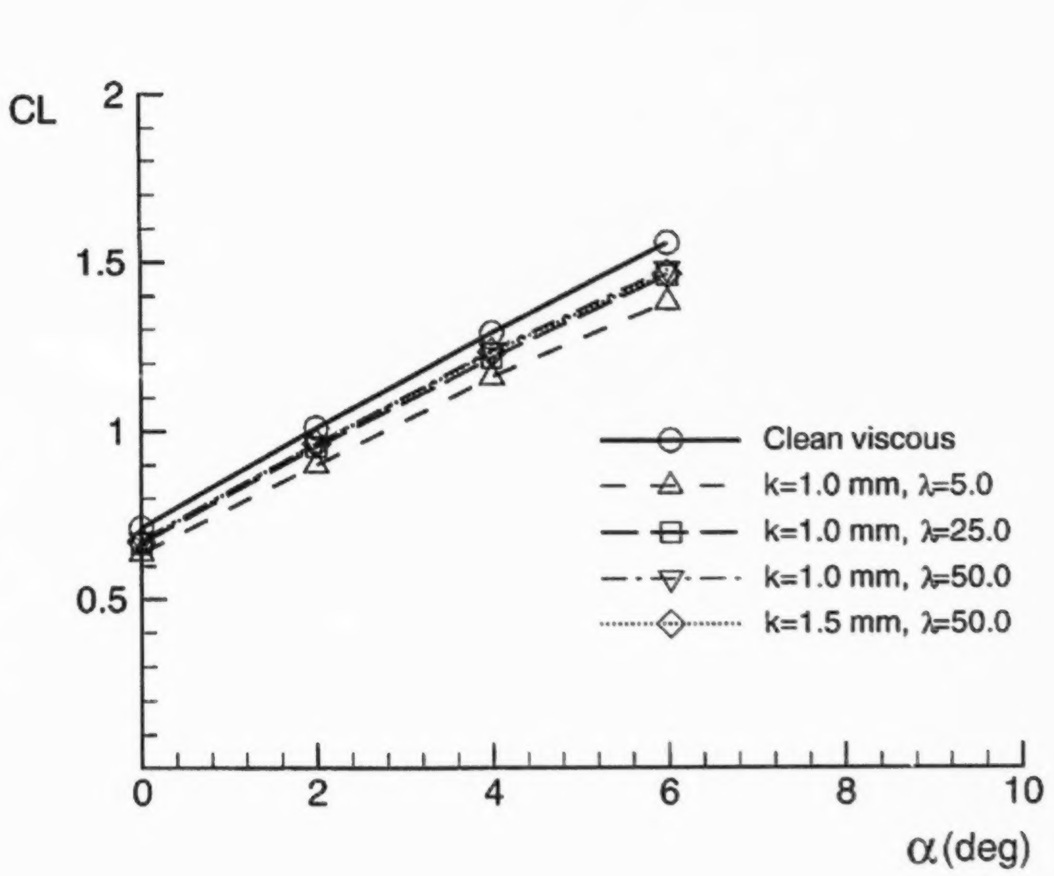


Figure 5 Comparison of the lift coefficient of the F28 with different roughness heights and densities.

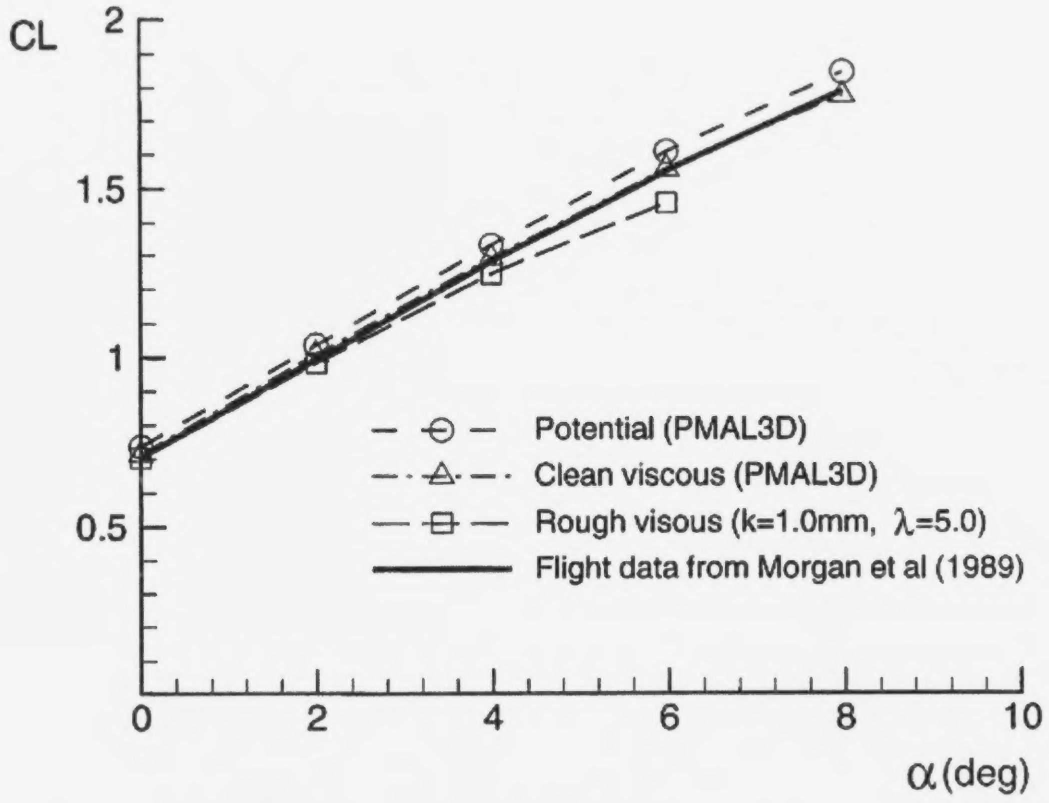


Figure 6 Influence of leading and trailing edge contamination on the lift coefficient of the F28.

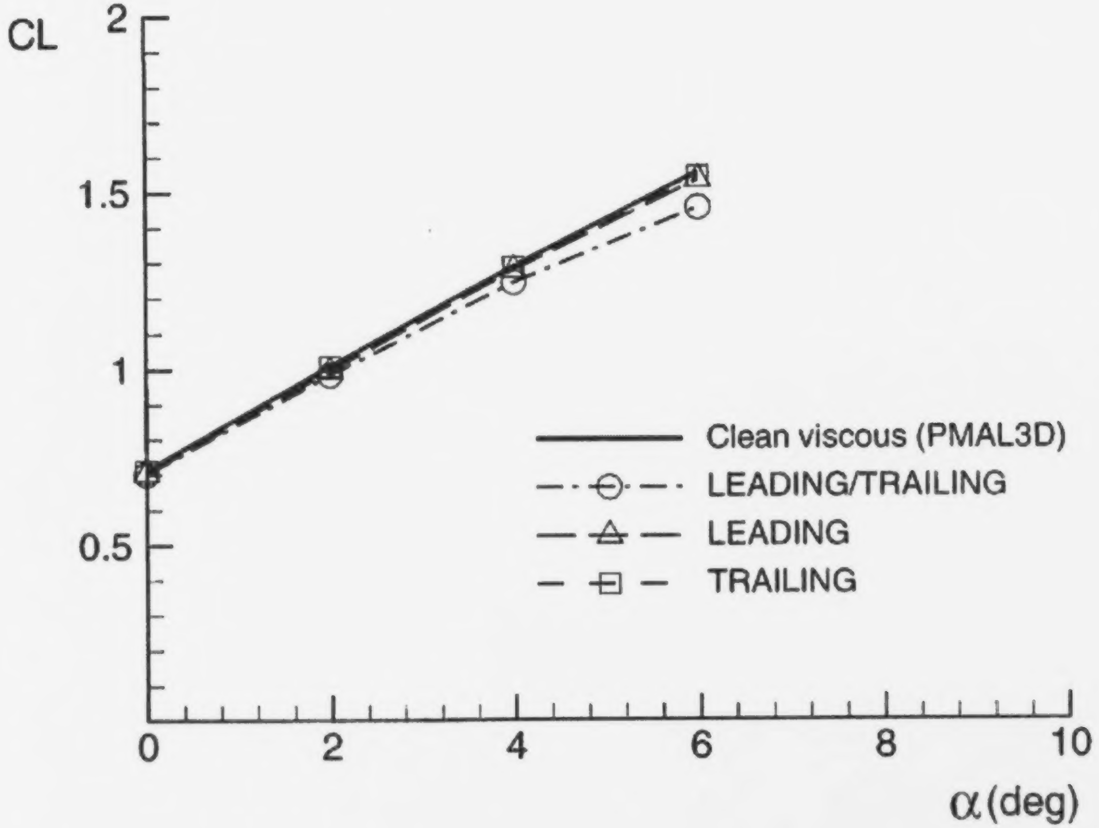


Figure 7 Influence of leading and/or trailing edge contamination on the lift coefficient of the F28 (k=1.0mm, λ=5.0).

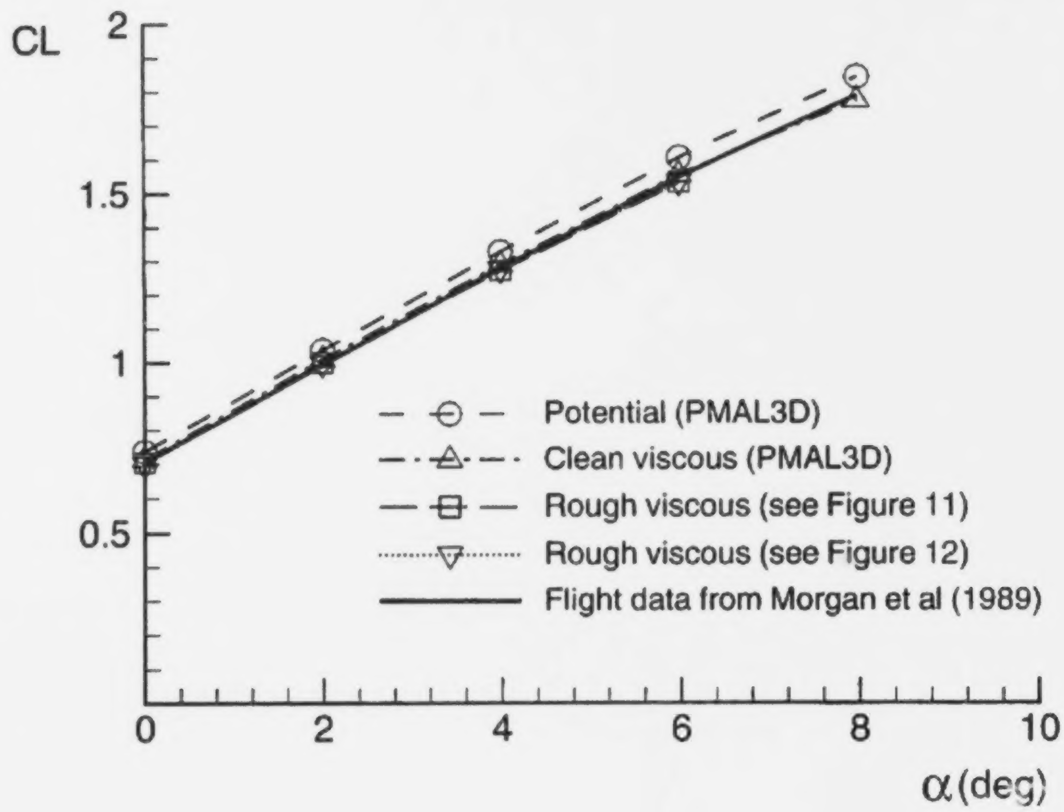


Figure 8 Effect of practical contamination conditions on the lift coefficient of the F28.

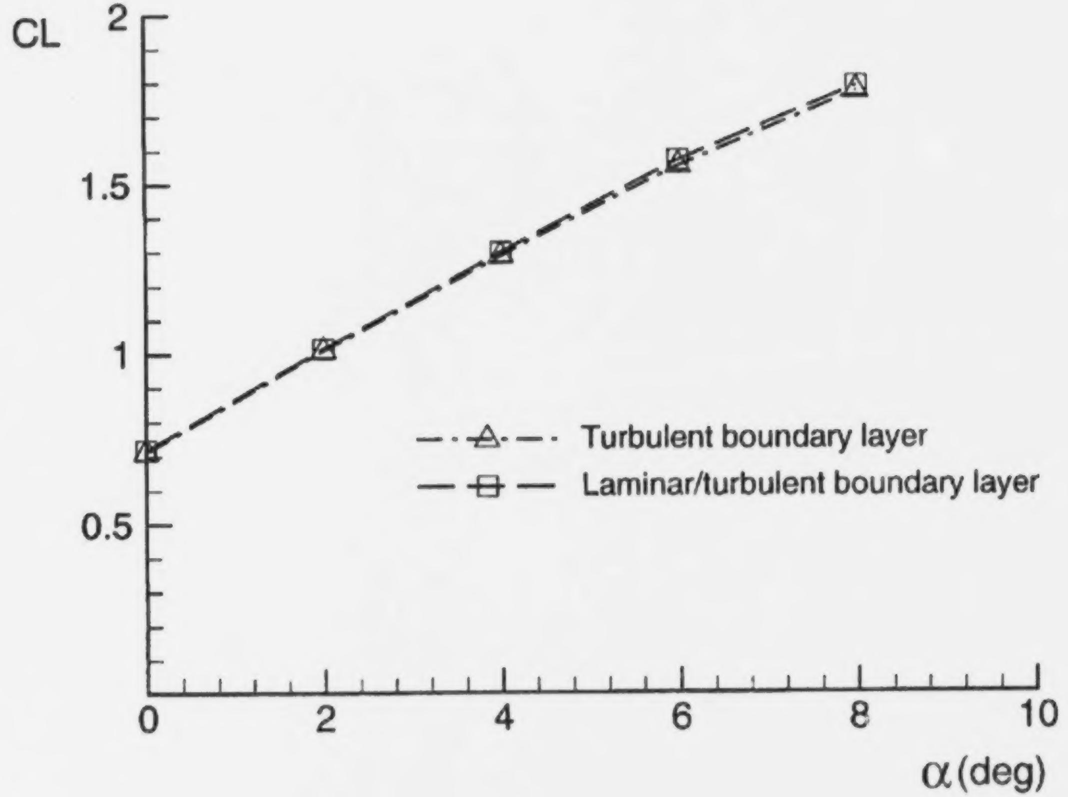


Figure 9 Influence of laminar/turbulent transition on the lift coefficient (no roughness).

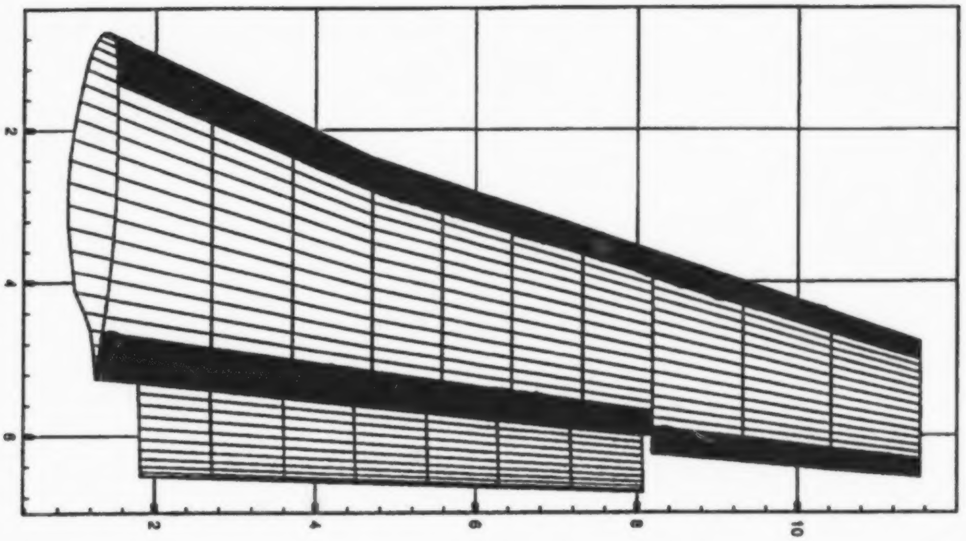


Figure 10 An assumed contamination pattern for roughness studies.

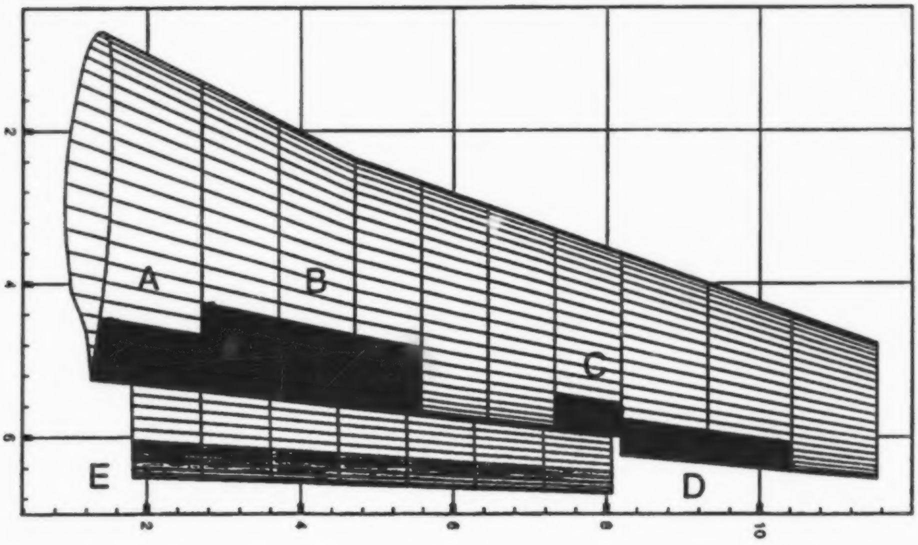

2
4
6
A
B
C
D
E
2
4
6
8
10

Figure 11 A practical contamination pattern with 20% wing failure.
A-D: k=1.0mm, λ=8.0; E: k=0.5mm, λ=50.0.

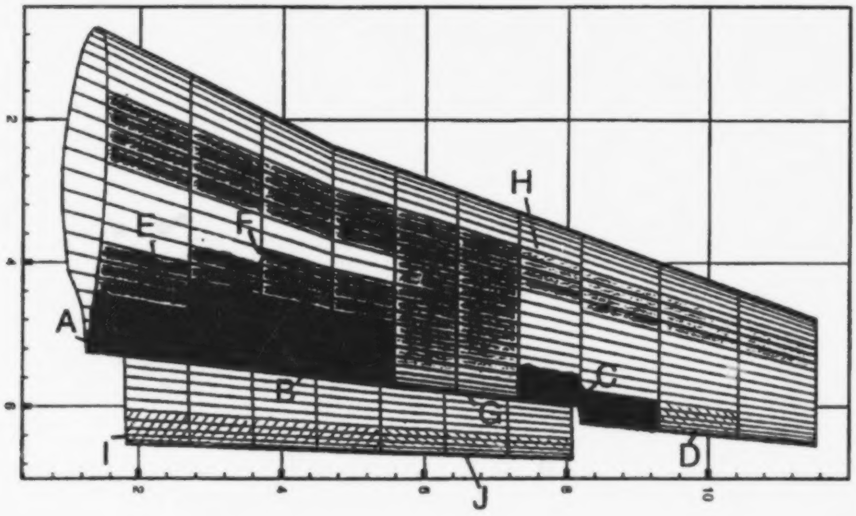

H
E
F
A
B
G
C
I
D
J
2
4
6
8
10

Figure 12 A practical contamination pattern with 75% wing failure. A-C: k=1.0mm, λ=8.0; E-H: k=0.2mm, λ=800.0; I: k=0.4mm, λ=50.0; D, J: k=0.5mm, λ=35.0.

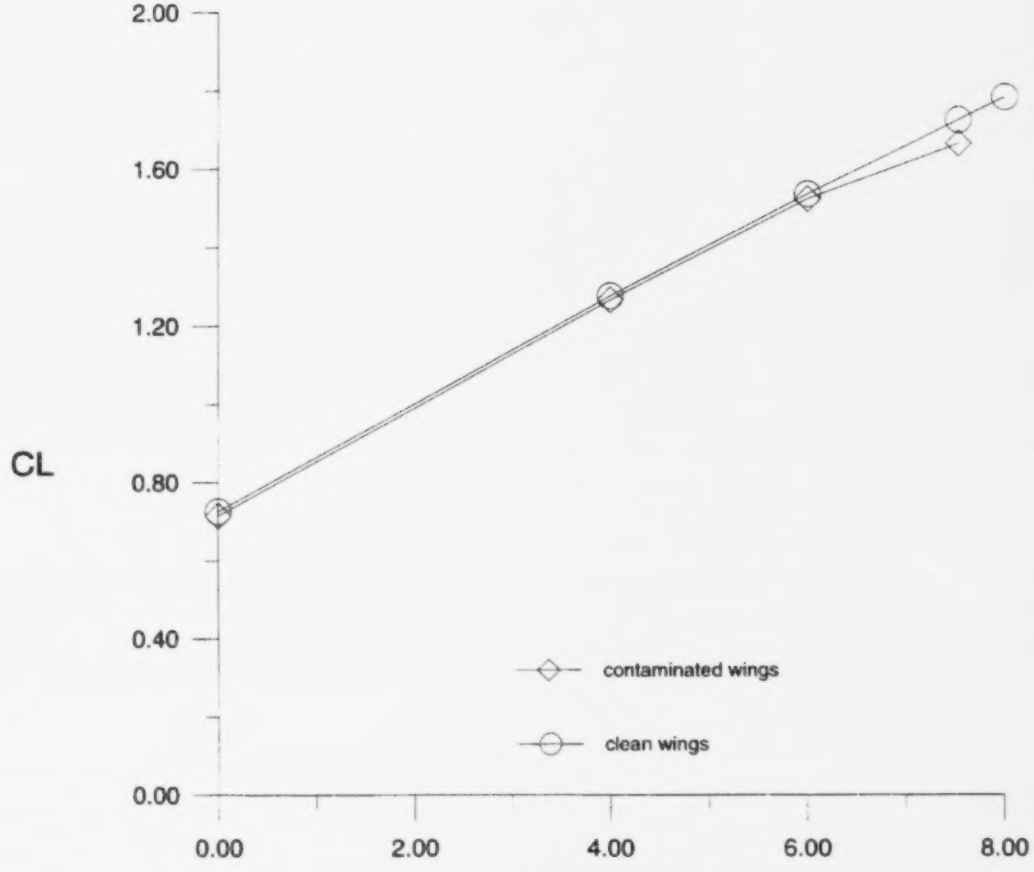


Figure 13

Lift curve of the F28 with light snow deposit on the wings

Appendix A

The simplest method of specifying the physical properties of surface roughness is in terms of the roughness height, k, the average frontal area of a roughness element, A_F, the average area occupied by a roughness element, D^2 and the average non-dimensional separation between elements, $\lambda = D^2/A_F$. D^2 is easily estimated by counting the number of elements in a given roughness area while A_F is assumed to scale with the square of the roughness height. Thus, $A_F = ak^2$ where a is itself a combination of factors accounting for the ratio of the average height to the height of the highest 20% of the elements and the average width-to-height ratio of the elements. Overall, a is about 1.0 so that the average spacing, or density of the roughness pattern, in the simplest case is $\lambda = D^2/k^2$. Note that this definition of λ in three-dimensional flow accords with the two-dimensional expression given in Dvorak (1969).

The full formula, $\lambda = D^2/ak^2$, for calculating λ was used for parts A and C of the wing in Figure 12. D^2 is one square inch for 115 elements, or 645.16/115 square mm per element. λ is, therefore 5.61/0.667=8.4 inasmuch as the roughness height in these areas is 1.0 mm and 0.667 is the ratio of the average roughness height to the maximum height. The lift loss is more sensitive to roughness height than roughness density so that slight errors in 'a' have little effect.